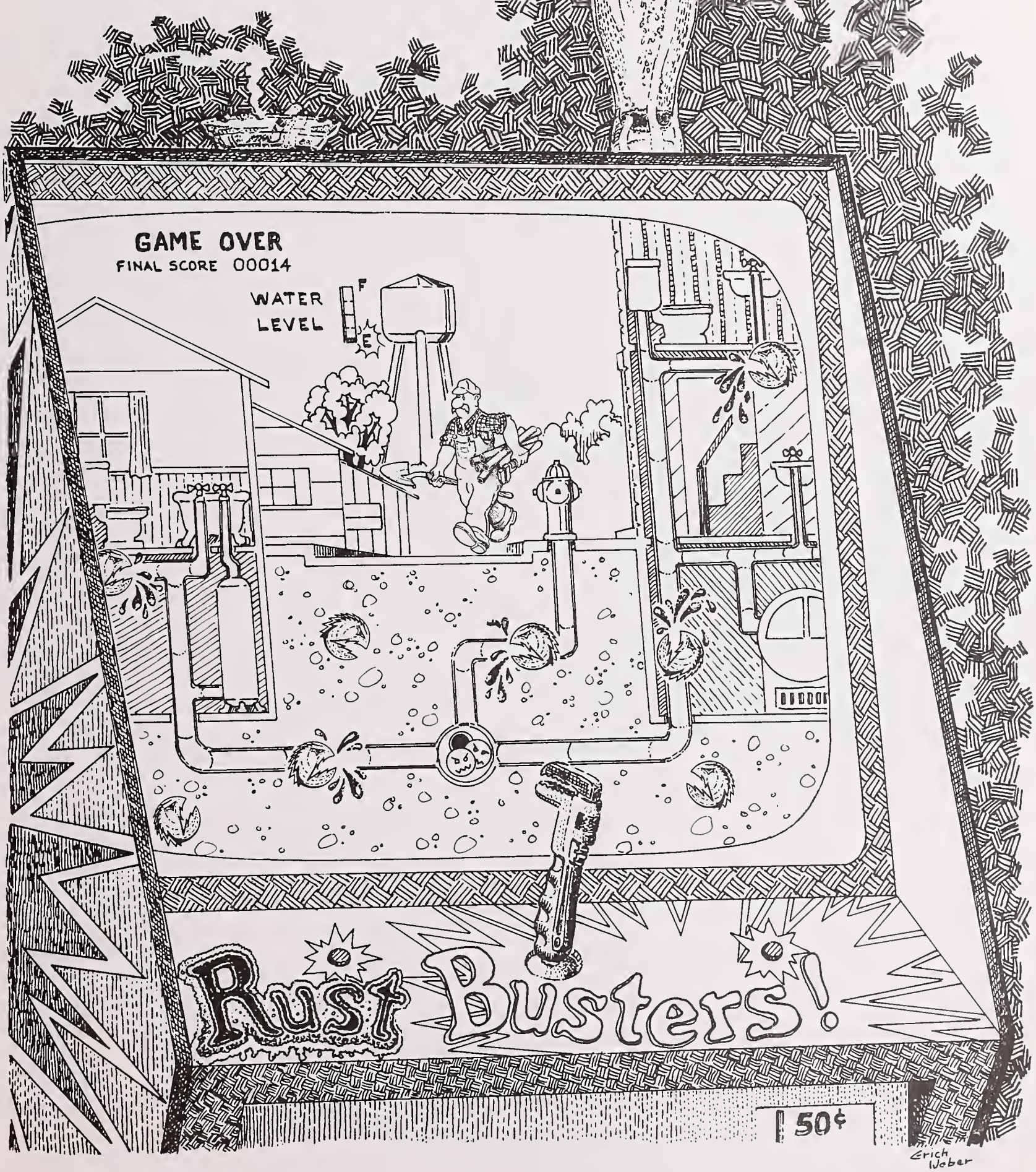
# Big Sky Clearwater



SPRING 1988



**CORROSION: CAN YOU BEAT IT?**



If you have any ideas or information that you would like to pass along to other people involved in the water and wastewater field, please don't hesitate to contact the office of the Water Quality Bureau. This publication welcomes articles of interest and random pieces of information regarding anything to do with water.

An article may consist of your own thoughts and ideas about something you may have experienced. Perhaps such information could help someone else in their day-to-day work. It could also be a technical article that is developed from research information and library resource material. If it has to do with water and you think it may be of interest, give us a call at the WQB: 444-2406.

If you do not wish to continue receiving this publication please send us your name and address so that we can remove your name from our mailing list.

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The Big Sky Clearwater is for water and wastewater operators across Montana. It is published two times a year by the Water Quality Bureau of the State Department of Health and Environmental Sciences in cooperation with the Montana Section of the American Water Works Association and the Montana Water Pollution Control Association.

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# INTERNAL CORROSION

By: Rick Rosa, Water Quality Bureau

Due to the age of many water systems in Montana or portions of such systems, corrosion of water mains has been a concern for quite a few years. Corrosion due mostly to the external environment surrounding the pipe has cost the taxpayer many a dollar in water main replacement cost.

Now with the passage of the amendments to the Safe Drinking Water Act, the concern is not only with the external corrosion of the pipe but also with the corrositivity of the water inside the pipe. Due to the possibility of lead being leached into the water supply, lead solder has been banned as a material used to join copper piping for household plumbing. Public notice will be required to be given by water utilities where lead could be a problem in a system supplied with water of a corrosive nature.

The Water Quality Bureau has been gathering data on the corrosive nature of public water supplies throughout the state of Montana over the past several years. Corrosive "indexes" have been determined every time an inorganic chemical analysis has been performed on a public supply. (Most of you are aware of the fact that such chemical analyses are required of public groundwater systems every 3 years and every year for surface supplies.)

Public water system operators should become aware of the corrosive properties of their water in order to properly maintain their systems and keep their water users informed of possible problems. It would also be a good idea to become aware of what causes a water to be corrosive in nature and what steps, if any, could be taken to eliminate the corrosive potential.

This article will attempt to provide some brief information concerning water quality and its impact on the corrosion process. It will not address the corrosion of pipe due to external factors (soil conditions, groundwater, etc.).

## Metals contain energy!

Corrosion may be thought of as the gnawing away of a material by some chemical or electrochemical means. Metals used for water system pipe are subject to this corrosive process. It doesn't matter if the pipe is used for the distribution system in the ground or if it is used for an interior plumbing system in someone's basement.

I once heard corrosion described as "nature's way of taking from man what man has taken from nature." Man takes a raw ore from

the earth and extracts different metals. It takes a good deal of energy to produce a finished metal from the ore and this energy is stored in the metal. The metal spends the rest of its natural life trying to give up this energy so it can return to its natural state - the raw ore.

The speed at which a metal corrodes depends on the amount of energy required in the manufacturing process. If it takes a lot of energy to separate the metal from the ore, there will be more energy stored in the metal. Having more stored energy will make the metal "active" or more apt to corrode.

For example, gold is easily separated from its ore and it is therefore very corrosion resistant. Copper requires low smelting energy and it is more corrosion resistant than other metals. Metals, such as zinc and aluminum, require more smelting energy and are therefore much more "active" and susceptible to corrosion.

How does corrosion occur?

Without going into a technical discussion of the reactions occurring during the corrosion process, I will attempt to explain how corrosion occurs.

The first thing to remember is that if a metal pipe is filled with water, some of the surface metal molecules will immediately go into solution. These metal molecules are positively charged. For each of these positive ions; one or more negative electrons is left behind in the metal. The metal is no longer neutral and electrochemical reactions will occur.

The more active a metal is (as defined above), the more positively charged ions that will go into solution. This will allow for more unstable metal left behind to react with the water it is in contact with. The water can allow for electrons to be removed from the metal and thus the metal is eaten away.

Please keep in mind that the above explanation is very simplistic but it will help you see why different kinds of water can create or inhibit corrosive problems.

What's in the water?

Now that you know that a metal is going to want to corrode when filled with water, you may wonder if different types of waters will have different effects on the pipe. All of the public water supplies around Montana differ in their chemical make-up and yes, this does make a difference with the corrosion process. Depending on what is in the particular water, the corrosion process will either speed up or slow down.
One of the most important water characteristics influencing corrosion is pH. pH is a measure of the concentration of hydrogen ions in solution. These hydrogen ions love to take any

electrons that the pipe is willing to give up so that hydrogen gas can be formed.

If the pH of the water is below 7, it is considered to be acidic in nature and there are more hydrogen ions present. The further you drop below seven, the more acidic the water becomes and more hydrogen ions will be present. The main point to remember is that more corrosion will occur with waters of a pH of less than seven.

The presence of chlorine in water will promote corrosion. It is an oxidizing agent which means that it will remove electrons from the metal. The use of chlorine gas for the purpose of disinfection causes a drop in the pH of the water and we already know what that does.

Another important ingredient in the water that will promote corrosion is oxygen. Oxygen will accept the electrons from the pipe. Deep groundwater usually contains very little oxygen and it is not a problem. However, if the public supply comes from a surface supply such as a creek or river, it is much more likely to contain oxygen and therefore be a problem. Shallow groundwater wells can also have a problem.

Hard water decreases corrosion and soft water increases corrosion. Mostly this is due to the fact that a scale is deposited on the pipe when the water is hard. This scale generally insulates the pipe from the water and thereby hinders the corrosion process. Of course, soft water does not allow the scale to build up and corrosion is enhanced.

A lot of dissolved minerals in the water increases the conductivity. The important thing to remember about increased conductivity is the fact that it promotes corrosion.

One other major constituent of the water that is of concern when you are looking at possible corrosion is alkalinity. In water chemistry, alkalinity is defined as the capacity of the solution to neutralize acid. A low alkalinity water only promotes corrosion.

## How corrosive is a particular water?

It would be very confusing if you had to try and figure out if a water was corrosive by looking at all of the concentrations of the above mentioned chemical characteristics. Perhaps one of these parameters indicates a corrosive water while another indicates the water is fairly neutral or slightly corrosive. How then would you categorize the water?

A method used to determine the corrosion potential of a particular water is the corrosion index. The above mentioned water characteristics are used to calculate such an index.

The most common indexes are the Langelier Index, the Ryznar Index and the Aggressive Index. These values predict the tendency of the water to either dissolve scale or deposit scale. In other words, it is an indication of whether the water will cause the pipe to be eaten away or whether the water will deposit a scale that protects the pipe. The most important thing to remember is that a water is either corrosive or scale forming (non-corrosive).

There really isn't much point in going into the mathematics and chemical equations regarding the indexes. It will suffice to say that our office computer automatically calculates these values every time there is an inorganic chemical analysis completed for your public water supply. As you are probably already aware and I mentioned this fact in the first part of the article, public water supplies are required to have this analysis done every three years for groundwater supplies and every year for surface water supplies.

If you are interested in obtaining information on whether or not your water is corrosive, please contact the Water Quality Bureau. We can furnish you with a computer printout of all the chemical data collected for your public water supply over the past ten years. This data was used to calculate the corrosive indexes and these values are listed on the printout. An explanation of the index values will be sent out with this computer sheet.

## What must be done if the water is corrosive?

What happens if you find out that the water is very corrosive? Maybe this is something you knew all along due to having seen the interior of some of your distribution pipe. Or perhaps a lot of homeowners have complained that their copper plumbing has deteriorated and had to be replaced.

There are ways of altering the chemistry of the water supply to deter corrosion. If the problem is very serious, your city, town, water district or water users association may want to consider hiring a qualified individual to evaluate your situation. The consultant needs to consider whether it is technically and economically feasible to do anything about the problem.

Keep in mind that if a treatment process is decided on, the installation must be designed by a professional engineer and the plans and specifications must be reviewed and approved by the Water Quality Bureau. The installation of the treatment equipment is not allowed until after approval of the design information.

To Summarize

Please keep in mind that the information in this article is very simplified (probably due to the simple mind of the author). I hope that it has offered a brief explanation of what internal corrosion is and how to obtain a relative measurement of the corrosive nature of your water.

Perhaps this information will cause you to look into corrosion and its' causes a little further. Maybe it will help you to understand why public notice regarding possible lead contamination is being required. You will hopefully be better able to answer the questions from the water users regarding this subject.

Don't hesitate to contact our office if you need the corrosive indexes for your water supply. These do not provide an absolute certainty that the water supply is coating or destroying all of the pipes in the system but they do provide a good indication of what is taking place.

Once again, if you are having some major problems with internal corrosion and your water quality information substantiates this, it would be a good idea to contact a qualified individual to look into the situation. Perhaps it would be feasible to do something about the situation. Remember that old adage about "an ounce of prevention is worth a pound of cure"?

One final note

This article did not go into the different forms of corrosion which may be taking place. It only refers to corrosion in the generic sense and the fact that the pipe is being eaten away. If you should look at a piece of pipe from the distribution system or a section of copper plumbing and discover that the corrosion is not uniform, there are reasons for what is occurring which were not addressed above.

The way in which the pipe is being attacked could be the subject of another paper. The pipe may be pitted or different portions could be corroding faster than others or one type of pipe may be eaten away while another is not. The reasons for these occurrences are clearly explained in available literature.

The point is that corrosion is a very complex subject and I recommend that you do some more reading on the subject if you are interested. Please don't hesitate to contact the Water Quality Bureau if you want further information and if we can't help you, perhaps we can point you in the right direction for finding someone who can.

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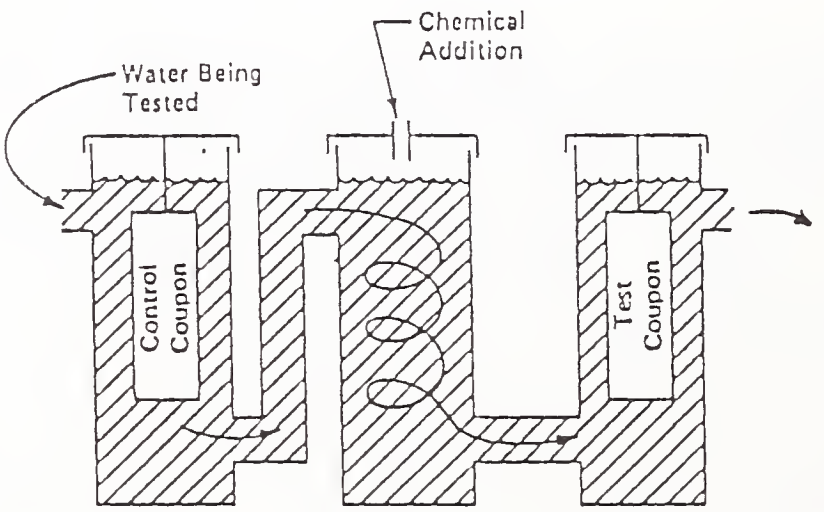
# TESTING FOR CORROSIVE WATER

By: Jan Cranor
City of Billings Water Treatment Plant

Are you interested in the corrosivity of the water leaving your treatment system or well? With the new amendments to the Safe Drinking Water Act and the potential for lead and other metals leaching into the water supply, many public water suppliers are looking more closely at testing and moderating the corrosivity of the water entering their distribution systems.

The water entering your system can be tested very easily using a testing cell and mild steel coupons. The test cell and coupons are available on loan at no cost from many corrosion inhibitor suppliers (they want to make a sale). The metal coupons can also be purchased to use for spot testing in a distribution system.

A test cell was installed at the Billings Water Treatment Plant that consisted of two sets of three small chambers (approximately 2 liters each) connected in series (see diagram below). Finished water from the plant entered the test cell at a rate sufficient to achieve a velocity of 1 foot/second across the mild steel coupons. The first chambers contained only the control coupon, the second were mixing chambers where a corrosion inhibitor could be added and the third chambers contained test coupons to show the effect of the corrosion inhibitor.




The corrosion inhibitors tested were zinc orthophosphate and sodium zinc phosphate. The sodium zinc polyphosphate has been used at the Billings Water Treatment Plant for several years. The test was run to see if any significant changes in the corrosion rate of the finished water had occurred and to compare the effectiveness of the zinc orthophosphate to the inhibitor we were using. The test cell was set up and run for 60 days. During that time the test cell was checked periodically to assure that the chemical feed and water flow rate remained constant.

A general guideline for corrosion measured in mills of corrosion per year (mpy) is as follows:

<2 mpy - excellent water/excellent protection
2 - 5 mpy - good water/good protection
5 - 10 mpy - acceptable water/acceptable protection
>10 mpy - poor, corrosive water

After the 60 day test period the coupons were sent back to the chemical supplier to weigh and determine the mpy corrosion rate. The coupons in the untreated water had a corrosion rate of 4.1 mpy which indicates that the water at the time of the test was of good quality without treatment.

The corrosion inhibitors were tested at two different concentrations; 0.10 mg/l (our current dosage) and 1.0 mg/l (the recommended dosage). The dosage we have used for several years gave a reduction in corrosion to 2.0 mpy and the recommended dosage resulted in a corrosion rate of 1.8 mpy. With the low corrosivity rate of our water, we decided to stay with the 0.10 mg/l dose to maintain a base level of corrosion protection.

Water varies greatly in corrosivity from one supply to another and a good way to determine the corrosive nature of your own supply is by this test cell method. A representative from Calgon Corporation ran the test for our facility; however, there are many companies that have similar test equipment available.

# ABC'S RECIPROCITY REGISTRY

The Association of Boards of Certification now offers examinations in Water Distribution, Water Treatment, Wastewater Treatment, and Wastewater Collection in four classes with Class 4 the highest. Those passing these examinations will receive a Reciprocity Registry Certificate which is renewable every three years by renewal fee of $25 plus three continuing education credits. To take an ABC exam, an application and non-refundable fee of $25 must be sent to ABC. Upon determination that the minimum qualifications for the exam selected have been met, ABC will notify the applicant of his/her acceptance and will set a testing date. There is a $25 examination fee to take an ABC examination. Montana has agreed to proctor ABC exams at our examination points and has ABC application kits available from the certification office. Qualifications to take an ABC exam include a minimum number of years of education and experience and current state certification. The application kits have instructions, rules for education and experience substitutions, and worksheets for classifying your plant/system. For further information, contact the certification office at 444-2691 or ABC, P. O. Box 786, Ames, Iowa 50010-0786.

# ALGAE IN PUBLIC WATER SUPPLIES

By: Loren L. Bahls
Water Quality Bureau

You're a water plant operator. It's a Monday morning in late September. You notice something different as you enter the plant but you can't quite put your finger on it.

The phone rings. It's your boss. *His* phone has been ringing off the hook all weekend. People all over town have been complaining about the water. It smells, especially the hot water. And it tastes awful.

Then you finally put your finger on it. There's a vague, musty odor permeating the plant that wasn't there Friday night.

Typically in the next few days you will learn all you can about taste and odor problems and the algae that cause them. You will consult with "the experts" and with operators from other plants. And you will experiment with control methods. But you will soon discover that no one has all the answers and that your plant has a limited ability to treat these problems.

## WHAT ARE ALGAE AND WHERE ARE THEY FOUND?

Like Giardia and other low life, algae are critters to be reckoned with in surface water supplies. Algae are small, often microscopic, primitive plants which lack specialized structures like roots, stems, leaves and flowers. But algae can do most things that higher plants do, and more: They can photosynthesize organic compounds; they respire and reproduce themselves; and some can even move around from place to place.

Algae function in most aquatic ecosystems on the earth's surface as the base of the food chain, the aquatic counterpart of grass. Algae are "grazed" by small spineless animals (mostly insects and crustaceans) and certain fish. Algae are important in wastewater stabilization ponds and are used in bioassays of toxic or growth-stimulating wastes and as pollution indicators in water quality assessment work.

Blue-green algae were probably among the first plants on earth. Some, over a billion years old, can be seen today in rock outcrops in Glacier National Park. There are several other groups of algae, which are distinguished mainly on the basis of light-gathering pigments and color. Altogether there are probably in excess of 2,000 species of algae in Montana.

Algae are seldom a nuisance in pristine waters. They usually cause problems only when they grow in profusion or "bloom." In Montana, algae blooms typically occur in summer in the surface waters of reservoirs that are fed by streams rich in nitrogen and phosphorus. The source of these nutrients may be natural, for example the phosphorus-rich soils of southwestern Montana. Or they may originate from wastewater discharges and land-management activities.

Standing waters (reservoirs and lakes) generally produce larger standing crops and more severe problems than flowing
waters. Some problems (toxic algae) are not known to occur in flowing waters, at least in Montana.

WHY ARE ALGAE A PROBLEM?

The most common algae-related water treatment problems in Montana are tastes and odors (T & O). T & O problems may appear if there's too much of any kind of algae, but some species are particularly offensive, namely certain flagellates and blue-greens.

Tastes and odors develop from byproducts of metabolism and decomposition as algae live and die in large numbers. Odors have been described as "grassy," "pigpen," "musty," "violet," "nasturtium," "geranium," "cucumber," and "muskmelon." T & O problems are typically worst during spring and fall "overturn" when a reservoir becomes isothermal and mixes from top to bottom. They can be made even worse by the addition of chlorine. This may also result in the formation of trihalomethanes, as chlorine mixes with algal metabolites that serve as the precursors of these hazardous compounds.

Algae may also clog filters and screens. Diatoms are the worst offenders. Filter and screen clogging algae are present in both standing and flowing waters.

A problem that has received a lot of publicity lately is toxic algae. Only certain species of blue-green algae are capable of producing toxins, but these species do not produce toxins all the time. Just why algae produce toxins and what triggers toxin production are two of the many mysteries of science. But we do know that toxins are produced only during a bloom and that blooms of bluegreens usually occur during the summer in nutrient-rich surface waters after a prolonged spell of hot, dry and windless weather.

In Montana, seven blooms of toxic blue-green algae have been documented in four different reservoirs: Canyon Ferry Reservoir in 1984; Nelson Reservoir in 1980; Lower Jocko Reservoir in 1986; and Hebgen Reservoir in 1977, 1985, 1986 and 1987. These toxic blooms were detected by the presence of dead cattle along the shore. The culprit was Anabaena flos-aquae in all seven cases.

Although blue-green algae toxins can be deadly to humans and cannot be removed or deactivated by conventional treatment, there is only a slight chance they would ever cause a problem in a public water supply. Intakes for public supplies are usually placed at a depth below the surface of a reservoir. Toxins produced in surface blooms would normally be diluted so much by the time they reach the intake depth that they would no longer be effective.

However, cabin owners and others who take their water from near the shore of a lake or reservoir and especially from near the surface of shallow bays, run the risk of ingesting a much more concentrated dose of toxin. Intakes should be placed well away from shore and in deeper water, but not directly on the bottom. No one in their right mind would drink water from an algae bloom, but the toxin may be released by the algae and become separated from the telltale blue-green scum.

Other problems caused by algae include the buildup of slime (biofilms, fouling, etc.), color and staining, corrosion, and interference with chlorination, coagulation and sedimentation. Occasionally, certain algae will survive treatment and persist in the distribution system and grow and multiply in open storage basins.

## HOW CAN ALGAE BE CONTROLLED?

Control of algae is best accomplished outside the treatment plant and before they become a nuisance. Environmentally safe control methods are based on altering or limiting the factors required for growth: water, light, temperature and nutrients. Since algae blooms are a symptom of eutrophication (the "overfeeding" of lakes and reservoirs), measures that slow down or reverse eutrophication also control algae blooms. The most common approach is to limit the input of nutrients from point and nonpoint sources, for example, fertilizers, household detergents, livestock and domestic wastes.

Most algacides are formulated with copper, which is also toxic to beneficial plants and animals, including fish. (Ironically, copper in small amounts is an essential trace element in algal metabolism.) Hence algacides normally cannot be used in multipurpose reservoirs. In fact, it is illegal to release toxic substances into state waters. Moreover, algae may develop a resistance to copper, requiring larger and larger doses to achieve effective control.

It is okay to apply copper sulfate or other algacides to holding basins or storage reservoirs that are part of a water supply system and dedicated solely to that purpose, provided treated waters are not released to state waters. But again, for best results, chemicals should be applied before a bloom develops. Be sure to read the label carefully and follow instructions closely. The effectiveness of copper sulfate will decrease as the hardness and alkalinity of the water increase. For human consumption, copper should not exceed 1 mg/L in finished water.

Other in-plant treatment methods that have been used with varying success include the addition of potassium permanganate, alum and activated carbon coupled with coagulation, sedimentation and filtration. Chlorine is also toxic to algae and may help to control growth in distribution systems. However, chlorine may combine with algal byproducts to form trihalomethanes, as noted previously.

Biologists of the Water Quality Bureau stand ready to identify algae on request. Algae samples and questions about algae may be directed to the author. The following books are recommended for further reading:

American Public Health Association, 1981. Standard methods for the examination of water and wastewater. Washington, D.C. 1134 pp. (color plates of algal.)

Palmer, C.M. 1977. Algae and water pollution. U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio 45268. EPA-600/9-77-036. 124 pp. (This is an illustrated manual on the identification, significance and control of algae in water supplies and in polluted water.)

Prescott, G.W. 1978. How to know the freshwater algae. Wm. C. Brown Company Publishers, Dubuque, Iowa. 293 pp.

# BACTERIA AND BOD REMOVAL

By: Doris Roberts, Northern Montana College

BOD stands for Biochemical Oxygen Demand. It is a measure of the degradable organics present in a wastewater. It is also called the "strength" of the wastewater.

To perform the BOD test, the amount of oxygen in a sample is measured and then the sample is incubated for five days. At the end of 5 days the amount of oxygen left in the sample is measured. (This is why you see the abbreviation $BOD_5$.) What can measuring the oxygen depletion over a 5 day period tell us about the degradable organics in the wastewater?

The organisms living in the wastewater system degrade the wastes. When the organisms break down the wastes (food to them), they use oxygen. The more food there is for them to eat, the more oxygen will be used. The less food, the less oxygen used. So, if you measure the oxygen depletion over a period of time, you are indirectly measuring the amount of food (degradable organics) in the wastewater.

How much BOD is removed from wastewater depends on:

1 - the microbes metabolic rate;
2 - the time given to the microbes to remove the BOD;
3 - concentration of microbes in the system.

Since all three factors listed above refer to microbes (organisms that are so small you need a microscope to see them), we will discuss their role in the removal of BOD. The specific type of microbes we will discuss are the bacteria. They are the principle actors when it comes to removing the organic wastes from the wastewater.

## Role of the Bacteria in the Reduction of BOD

The bacterial population of a wastewater system metabolizes the incoming wastes. That is, the bacteria use the wastes as a source of food. Substances that are dissolved in the water are absorbed by the bacteria (the substances are taken into their cell body). Once inside, with the aid of enzymes (chemicals that speed up a reaction) the substances are broken down further.

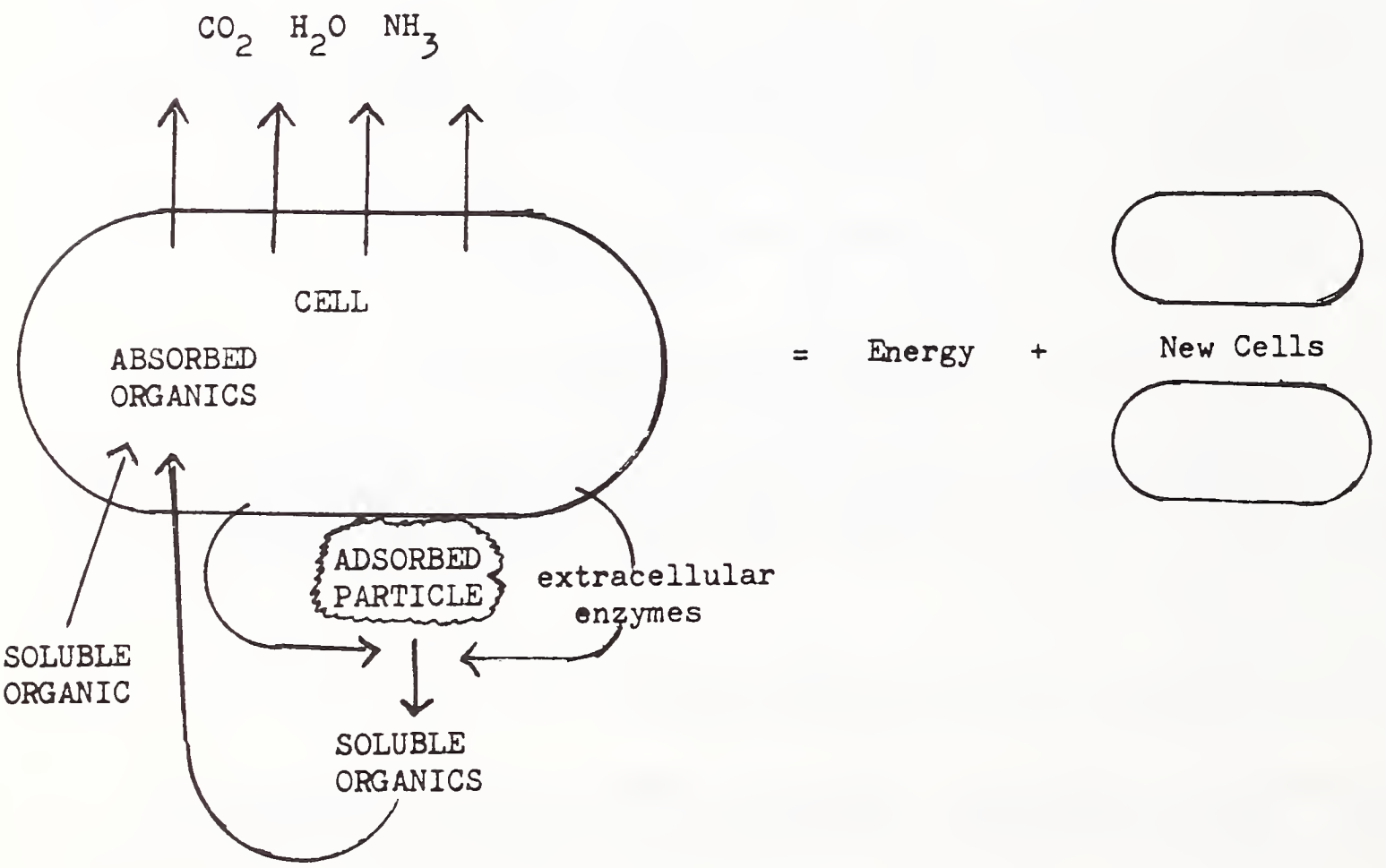
Particulate organics that are too large to pass through the cell membrane, have to be broken down outside the cell before they can be absorbed. These particles are adsorbed (gather on the surface of the cell) and enzymes are sent out of the cell so they can be broken down. When small enough, they are absorbed by the cell.

When the bacteria "eat", the food is converted into energy and new cellular material. We use our food for the same things; to provide energy for our life functions and grow new cellular material. All of us know what happens when we

eat too much -- we GROW. The bacteria grow, but when they reach a certain size they divide --- where there was one, there is now two. The bacteria also produce wastes. These wastes can serve as food for other microbes. We can express the BOD removal process as an equation:

$$\text{Food} + O_2 + \text{Bacteria} \longrightarrow \text{Energy} + \text{New Cells} + \text{Metabolic Wastes}$$

Diagrammatic Representation of BOD Removal




Aren't bacteria great! Who else can you find that will work 24 hours a day, 7 days a week, for just room and board!

# GROUNDWATER POLLUTION CONTROL IN MONTANA

By: John Arrigo - Water Quality Bureau

Two percent of the total amount of water used in Montana is ground water. Most of the water used in the state is surface water diverted for irrigation.

This information suggests ground water resources do not play a significant role in Montana's development. However, the picture changes when the uses of that ground water are considered. More than half (55 percent) of Montana's population obtains its potable water from ground water sources. The need to protect the quality of our limited ground water supplies is therefore obvious.

## REGULATIONS DEVELOPED TO PROTECT GROUND WATER

The Montana Board of Health, on October 29, 1982, promulgated rules for the Montana Ground Water Pollution Control System (MGWPCS). These ground water regulations are administered by the Department of Health and Environmental Sciences/Water Quality Bureau (DHES/WQB). A copy of the MGWPCS regulations can be obtained by contacting the WQB.

The MGWPCS regulations include a ground water classification system, ground water quality standards, a nondegradation policy and a permit program. The regulations also provide DHES with emergency power to require corrective actions when a spill or unanticipated release of materials threatens ground water quality.

The classification system and standards are based on existing quality as of October, 1982. However, statewide mapping and classification of aquifers in Montana has not yet occurred. The existing quality of ground water is evaluated on a case-by-case basis when a MGWPCS permit application is received for a particular site. The nondegradation policy means that the existing ground water quality cannot be made worse unless it has been demonstrated to the Board of Health that a change is justifiable as a result of necessary economic or social development.

## POSSIBLE "POLLUTERS" MUST HAVE A PERMIT

The MGWPCS permit program is designed to regulate existing or potential sources of ground water pollution. Any business or operation that stores process materials or wastes in such a manner that hazardous constituents can leak into the underlying ground water must obtain a MGWPCS permit. Activities or operations required to obtain a permit from another program or agency, such as a hazardous waste permit from the DHES or a mine operating permit from the Department of State Lands, are excluded from the MGWPCS permitting process. However, these operations must still meet ground water quality standards and satisfy the nondegradation policy.

Approximately 45 applications for MGWPCS permits have been received since the inception of the program. At the present time, only about 30 of the permitted facilities are active. The majority of MGWPCS permits are for small, precious metals extraction operations. Most of the small metal operations are heap leach facilities where a caustic cyanide solution is sprinkled over ore to dissolve out the gold. The function of the permit is to ensure that adequate ground water monitoring is in place to detect any leaks or spills from leach pads and ponds.

FOLLOW-UP ON ACCIDENTAL SPILLS AND LEAKS

Another important function of the MGWPCS is to follow-up on accidental or unanticipated releases of materials that threaten ground water quality. The MGWPCS regulations require the person responsible for a spill or unanticipated discharge to notify the 24-hour Montana Hazardous Materials Response System (406-444-6911) and provide all relevant information about the spill.

Spills that threaten surface or ground water quality are routed to the WQB. Approximately 85 separate spill incidents were reported to the WQB during 1987. These incidents account for over 570,000 gallons of spilled materials. The majority of the spilled material (70 percent) was saltwater and crude oil that leaked from pipes and miscellaneous plumbing located at oil production areas in Montana. The second largest category of spilled material was approximately 160,000 gallons of fuel (gasoline or diesel) released from pipeline leaks, tanker truck wrecks, or spilled while filling storage tanks.

WQB staff work with responsible parties to try and get the spilled materials cleaned up before they can soak into the subsurface and pollute underlying ground water. Large quantities of soil must sometimes be removed so that future precipitation will not infiltrate through contaminated soil and transport hazardous constituents down to the water table. If all of the residual contamination cannot be removed, monitoring wells must be installed to check and see if ground water is contaminated.

Leaks from underground petroleum storage tanks are unseen and often go undetected for several months or even years. Clean-up of leaks from underground fuel tanks is very difficult because the fuel can spread over large areas before it is detected. (Refer to the article by Bill Clark in this issue which describes what can happen at an underground tank leak site.) Investigation of leaks from underground storage tanks is another primary function of the MGWPCS. A regulatory program to control leaking underground storage tanks is currently under development. Regulations which mandate a specific level of corrective action at leak sites will be developed by the end of 1988.

FLAMMABLE WATER?

Almost 60 complaints were received during 1987 in which ground water contamination by petroleum was alleged. Corrective actions, such as contaminated soil removal, recovery of fuel floating on the water table and installation of ground water monitoring wells, were necessary at 40 of these sites. Some level of corrective action, primarily ground water monitoring to track pollutant movement, is ongoing at 30 different leak sites in Montana.

Whenever fuel is found floating on the water table, the WQB has required that this product be recovered. For example, nearly one-half million gallons of diesel has been pumped from the ground at the Old Milwaukee Railroad yard in Miles City. However, usually free product recovery systems remove only 20 to 50 percent of the fuel from the subsurface. This is due to the fact that much of the fuel adheres to the surface of gravel, sand, silt and clay particles.

WHO FUNDS THIS WORK?

Funding to administer a ground water pollution control program in Montana is provided to DHES by the U. S. EPA. A portion of these funds are utilized to conduct studies of ground water contamination problems in Montana. Studies currently underway are looking at the effects of septic tank drainfields on shallow ground water in the Evergreen area of Kalispell, the vulnerability of the Missoula Valley aquifer to contamination, and the extent of pesticides in ground water at two locations.

WHAT DOES ALL THIS GROUND WATER STUFF HAVE TO DO WITH WATER AND WASTEWATER PLANT OPERATORS?

You should be aware of the fact that there is a ground water pollution control program operated by the WQB. If you have any questions about ground water you should feel free to contact the WQB staff. We are interested in hearing about any incidents or problems that you think might affect ground water quality in your area.

If you operate a water supply system which obtains its water from wells, you should realize that the ground water tapped by those wells has sometimes traveled great distances. Any sources of pollution situated along the ground water flow path could conceivably release pollutants into the ground water and degrade the water supply. As a responsible water supply system operator, you should make it a point to examine pollution sources in the vicinity of supply wells. Familiarize yourself with potential sources of pollution and try to anticipate what ground water quality problems may arise in case of an accident.

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# FOR SALE

The Willow Creek Sewer District has the following items for sale:

1. One Nord Gear Corporation Helical Gearmotor with Helical speed reducers used as a turbine mixer.
2. One telescoping valve.
3. Twenty four 3/8-inch Snap-Cap diffusers.

If you are interested in any of these items please call Joanne Schneider at 285-6686.

# 1988 JOINT MSAWWA/MWPCA CONFERENCE

**March 16, 17, 18, 1988**
**Colonial Inn, Helena, Montana**
(1.0 CEC)

**WEDNESDAY, MARCH 16** **AFTERNOON AND EVENING**

1:00 - 5:00 Registration/Exhibit Area Open
3:00 - 5:00 Welcome/Business Meeting
5:00 - 7:00 Reception and Light Buffet in Exhibit Area
Water Taste Test Competition

**THURSDAY, MARCH 17** **MORNING**

7:30 - 8:00 Registration/Coffee and Rolls in Exhibit Area

**Joint Session**

8:00 - 9:00 1986 Safe Drinking Water Act Amendments.
Mark Alston, EPA Region VIII, Denver

**Concurrent Sessions**

9:00 - 9:45 a. Montana's Surface Water Treatment Program.
Donna Howell, WQB
b. Performance Limiting Factors in Wastewater Treatment. Dick Pederson, WQB

9:45 - 10:15 Break, Exhibit Area

**Concurrent Sessions**

10:15 - 11:30 a1. Funding Capital Improvements and Operating Revenue. Roundtable Discussion with WQB, CDBG, DNRC, D.A. Davidson, FmHA
11:30 - 12:00 a2. Selecting a Consultant.
10:15 - 11:00 b1. Pride in Your Facility Means Public Acceptance
11:00 - 11:30 b2. Computer Applications for Control & Data Management.
11:30 - 12:00 b3. Proposed Requirements and Techniques for Bio-Monitoring.

12:00 - 2:00 Luncheon/ AWWA Past Pres. Robert Chuck
WPCF Vice Pres. Art Saarinen

**AFTERNOON**

**Concurrent Sessions**

2:00 - 2:45 a. Solids Inventory Control in Secondary Wastewater Basins
b. Clark Fork River Pollutant Inventory Study
2:45 - 3:30 a. Volatile and Synthetic Organic Chemical Contaminants and their Removal.
Mark Alston, EPA Region VIII, Denver
b. Collection System Maintenance and Root Control

| | |
|---|---|
| 3:30 - 3:45 | Break, Exhibit Area |
| 3:45 - 4:30 | a. Radon Gas Occurrence and Removal in Water Supplies. Adrian Howe, Occupational Hlth Bur.<br>b. Lift Station Operation and Maintenance |
| | **Joint Session** |
| 4:30 - 5:00 | Alternatives to Chlorine Disinfection of Water and Wastewater. Ken Johnston |
| | **EVENING**<br>**"A Night On The Town"** |
| 5:00 - 6:00 | No-Host Cocktails at the Montana Club |
| 6:00 - 12:00 | Banquet at the Montana Club, followed by a performance of "The Three Musketeers" and presentation of the Fuller and Hatfield Awards at the Grand Street Theater. |

| | |
|---|---|
| **FRIDAY, MARCH 18** | **MORNING** |
| 7:30 - 8:00 | Coffee and Rolls in the Exhibit Area |
| | **Joint Session** |
| 8:00 - 8:45 | Hazardous Waste Regulations and Case Histories. Vic Anderson, Solid & Hazardous Waste Bur. |
| | **Concurrent Sessions** |
| 8:45 - 9:30 | a1. Design and Applications of Floating Reservoir Covers. Locke Robertson, Columbia Reservoir Systems, Ltd. |
| 9:30 - 10:00 | a2. Lagoon Liner Installation and Maintenance |
| 8:45 - 10:00 | b. Occurrence and Control of Iron Bacteria in Well Supplies. Dr. Cullimore, Univ. of Regina |
| 10:00 - 12:00 | Joint Business Meeting MSAWWA/MWPCA |
| 12:00 - 2:00 | Luncheon/MSAWWA & MWPCA Awards, & Sapphire Drawing |
| | Closing Meeting and Adjourn |

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# WATER TASTE TEST CHALLENGE

Does your public water supply have the best tasting water in Montana? The 1988 MSAWWA/MWPCA Conference will hold the Second Annual Drinking Water Taste Test. Bring a water sample to the conference and the judges will determine the best of the best.

To enter, bring a liter of water from the distribution system to the registration desk on Wednesday afternoon. Final judging will take place at the reception that evening.

*PREREGISTRATION FORM *
1988 ANNUAL AWWA/WPCA CONVENTION
MARCH 16-18, 1988
HELENA, MT

*Preregistrants will automatically be entered in the drawing for a sapphire earrings and necklace set. The earrings and necklace are donated by Dick Montgomery of Helena and will be given away at the Friday luncheon. Late registrants will not be eligible for this drawing unless tickets are purchased for the drawing at the convention. Late registrants will also not be eligible for the special room rates at the Colonial Inn.*

Preregistration information must received by March 2, 1988! Make checks payable to the **AWWA/WPCA Host City Committee** and mail it along with the following information to:

AWWA/WPCA Host City Committee
c/o Water Quality Bureau
Cogswell Bldg.-Rm A 206
Helena MT 59620

Name_____
last first middle initial
Title_____

Organization_____

Mailing address_____
street or PO Box

_____
city and state zip code
Spouse/guest name (if attending)_____

Will you need a bus ride to the Thursday night banquet and play?
__Yes__No If yes, please indicate the number of people:_____ .

*If you preregister by March 2*, you can receive special room rates at the Colonial Inn. Please contact the Colonial Inn, 2301 Colonial Drive, Helena 59601 (phone 406-443-2100) by March 2.

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* REGISTRATION FEES *

| | |
|---|---|
| AWWA and/or WPCA members | $ 75.00_____ |
| AWWA and/or WPCA members (one day only) | 50.00_____ |
| Non-members* | 85.00_____ |
| Non-members (one day only)* | 60.00_____ |
| Spouse (all meals included) | 20.00_____ |
| Additional luncheon tickets __Thu __Fri | 7.00_____ |
| Additional Thursday banquet tickets | 18.00_____ |
| Total Remitted | $ _____ |

*Non-members joining now-enclose completed membership application and 1 year's dues, then register as a member.

# AMERICAN WATER WORKS ASSOCIATION MEMBERSHIP APPLICATION

Complete this form and mail to:
AWWA / 6666 W. Quincy Avenue / Denver, CO 80235 / (303) 794-7711

**INDIVIDUAL**

CWPRF _
AWWA USE ONLY

PLEASE PRINT OR TYPE

LAST NAME _____ FIRST NAME and middle initial _____

MAILING ADDRESS _____

CITY _____ STATE OR PROVINCE _____ ZIP CODE _____

AREA CODE _____ TELEPHONE _____

TITLE _____

EMPLOYER'S NAME (if not already in mailing address) _____

APPLICANT'S SIGNATURE _____ DATE _____

SIGNATURE OF AWWA MEMBER ENDORSING APPLICATION (Optional) _____ ENDORSER MEMBER NUMBER _____

ANNUAL DUES $_____

NEG Assessment* _____

Multi-Section Option (other than own) _____

Total Due $_____

| Check One | Grade Code | Annual Dues |
|---|---|---|
| ☐ Active | 02 | $53.00 |
| ☐ Affiliate (Strictly for operator-level personnel or employees of small utilities) | 06 | 24.00 |
| ☐ Student (Must be enrolled and carrying at least 10 credit hours) | 14 | 15.00 |

*Applicants with an address in the New England Section (ME, NH, RI, VT, MA) are required to include an assessment of $26.50 with their AWWA dues.
Multi-section membership on reverse side.

Make check payable to AWWA (Canadian funds add 15%)

☐ American Express ☐ Diner's Club ☐ MasterCard ☐ Visa

Credit Card No. _____

Exp. Date _____

☐ Send invoice

If you have been a member of AWWA before, indicate dates here:

_____

ALL APPLICANTS SHOULD COMPLETE THIS SECTION:
Circle the descriptions below that best describe you. The information is used in audits of AWWA readership.
Circle only ONE in each group.

1. BUSINESS AND INDUSTRY
A. Public Water Supply Utility – Municipally Owned
B. Public Water Supply Utility – Investor Owned
C. Governmental – Federal, State, Local
D. Consultant
E. Contractor
F. Private Industrial Systems or Water Wholesaler
G. Manufacturer of Equipment & Supplies Including Representatives
H. Distributors of Equipment & Supplies Including Representatives
I. Educational Institutions, Faculty and Students, Libraries, and Other Related Organizations
J. Fully Retired
K. Research Labs

2. JOB TITLE
A. Executive – Gen'l Mgr., Commissioner, Board Member, City Mgr., Mayor, President, Vice-President, Owner, Partner, Director, etc.
B. Management – Division Head, Section Head, Mgr., Chief Engineer, Comptroller, etc.
C. Engineering/non-managerial – Civil Engr., Mech. Engr., Envir. Engr., Planning Mgr., Field Engr., Systems Designer, etc.
D. Scientific/non-managerial – Chemist, Biologist, Biophysicist, Researcher, Analyst, etc.
E. Purchasing – Purchasing Agent, Procurement Specialist, Buyer, etc.
F. Operations – Foreman, Operator, Maintenance, Crewman, Service Rep., etc.
G. Marketing & Sales/non-managerial – Mkt. Analyst, Mkt. Rep., Salesman, Sales Rep., etc.
H. Other (describe) _____

_____

CHECK FIELD(S) SERVED:
5 ☐ Water Supply Only
7 ☐ Wastewater Only
9 ☐ Both
3 ☐ Other

In some AWWA sections, a portion of the section allotment equal to 50 percent or more of the domestic subscription rate charged for the section periodical will be allocated toward a subscription of that periodical.

Dues allocated for each publication members receive:
*Journal* $25
*Mainstream* $6
*OpFlow* $5
*Waterworld News* $5

## Water Pollution Control Federation

601 Wythe Street
Alexandria, Virginia 22314-1994

**Association**

Montana Water Pollution Control Association

Use this application to join the Water Pollution Control Federation and your local Member Association. Simply complete this application and return it to the address below. Along with your monthly publications, you are also entitled to group insurance, technical assistance, discount on technical publications, and much more!

Please print.

First Name, Middle Initial _____ (11) Last Name _____ (16) (Jr., Sr., etc.) _____ (3)

**Mailing address** ☐ Business or ☐ Home

Business Name (if applicable) _____ (30)
Street or P.O. Box _____ (30)
City _____ (20) State _____ (2) Zip Code _____ - _____ (9)
Area Code—Telephone _____ - _____ (10) Country (If Outside U.S.) _____ (16)

WPCF Sponsor (Not Required) _____ (26) Sponsor's Member I.D. Number _____ (6)

**Employer Code** ___ (2)

11 – Local/Regional Government/Agency
13 – State/Interstate Government/Agency
16 – Federal Government/Agency
21 – Consulting Firm (Engineering/Other)
25 – Wastewater Equipment/Material/Supplier
27 – Industry
28 – Construction Contractor
31 – Educational Institution
61 – Other (Please specify): _____

**Education Code** ___ (1)

1 – Less than High School
2 – Training Courses, Short School
3 – High School
4 – Attended College
5 – Completed Junior College
6 – Bachelor's Degree
7 – Advanced Degree

**Membership Categories**

| ☐ Active | ☐ Operations Division | ☐ Student | ☐ Corporate |
|---|---|---|---|
| For individuals involved or interested in the advancement of knowledge pertaining to water quality. | For individuals working on a day-to-day basis (or retired from) in a wastewater collection, treatment, or laboratory facility. | For individuals enrolled at least half-time in a college or university. | For companies engaged in the design, construction, operation or management of water quality systems. |
| Dues $55.00 | Dues $22.50 | Dues $19.50 | Dues $180.00 |
| *Journal* Included | *Journal* ☐ $30.00 | *Journal* Included | *Journal* Included |
| *Highlights* Included | *Highlights* ☐ $15.00 | *Highlights* Included | *Highlights* Included |
| *Forum* ☐ $12.50 | *Forum* Included | *Forum* ☐ $12.50 | *Forum* Included |
| TOTAL $_____ | TOTAL $_____ | TOTAL $_____ | TOTAL $_____ |

**Method of Payment**

☐ Check Enclosed—Make check payable to WPCF.
☐ Charge my ☐ VISA ☐ MasterCard ☐ American Express

Account Number _____ Exp. Date _____

Signature _____ ( ) Daytime Phone No. _____

Send Completed Application and Payment to:

**WPCF, Member Records**
601 Wythe Street
Alexandria, Virginia 22314-1994

*For more information, call (703) 684-2452*

Postal Requirement: Dues allocated for publications when included in membership: *JWPCF* — $15; *Highlights* — $3; *Operations Forum* — $5.

**MEMBERSHIP APPLICATIONS – for more information contact your association membership chairman**
**AWWA: Donna Howell 444-2406 WPCF: Kristi Kline 265-9031**

# MSAWWA - "ALL FOR ONE"

## FOR THE DRINKING WATER INDUSTRY

Montana's American Water Works Association wants to keep our growth alive. Although budgets are tight, drinking water regulations are getting even tighter. Keep informed, get involved, and have a voice in the outcome of these regulations with AWWA.

AWWA is already providing information to help systems comply with the new laws through Journal articles and tips in OPFLOW. If you are missing out, now is a good time to join. For more information or Organization Membership applications contact:

Donna Howell
Cogswell Building, A 206
Helena, MT 59620
444-2406

or

Clint Tinsley
414 E. Callender
Livingston, MT 59047
222-1142

Welcome New Members!: Scott Craigle - Helena
Steve Dyce - Billings
Ernest Eddy - Dillon

Thanks Recruiter: Donna Howell (2)

We've also been joined by 13 Multi-Section Members since that program began. You too can join other AWWA Sections by paying $10.00 for each additional section ($26.50 for New England).

Welcome to the Montana Section, and thanks for your interest:

Patrick Geluso, Ranney Method
Larry Cole, MN Dept. of Health
Linda Hollomon, Nalco Chemical
Charles Dilaura, Neptune Meters
Ray McCormack, Texas Foundries
Gary Carrol, Montgomery Engrs.
Alexander Lapteff, Lapteff Assoc.
Jack Firkins, HACH
Tim Hudson, Yellowstone
David Bennion, CH2M Hill
Wayne Kerns, Black & Veatch
Alfred Kinter, Sheridan WTP
Jerry Liffrig, J M Manuf.

**Sponsors** - Free Dues (up to $53.00 value) For Top 1988 Recruiter!
To continue promoting the national "All For One" membership campaign, MSAWWA will extend the free dues offer to award the top recruiter for 1988. Sponsor the most new members in 1988 and MSAWWA pays for two years of your Affiliate Membership or one year of Active Membership.

ALL FOR ONE

# WORK SAFETY

The following is a newspaper article (Sun News - Myrtle Beach, S.C. 8/12/87) reprinted in the Safety and Occupational Health Bulletin put out by the Water Pollution Control Federation. The purpose of putting this article in the Clearwater is to once again drive the point home that operators must not enter confined spaces without taking the proper safety precautions and using the necessary equipment.

Perhaps some of you operators attended the session on confined space entry at last year's Water and Wastewater School in Bozeman. You people are very much aware of the dangers involved. For those of you who weren't in attendance, it would be a good idea to take a look at your procedures for working in the confined spaces of your facilities and perhaps seek information on proper precautions and equipment necessary to be able to work safely.

Perhaps one other item should be mentioned. I know that all of us think that an accident will only happen to the other guy and because we have never heard of a particular accident occurring, we assume that chances are slim that there will be any danger. However, the above mentioned bulletin is published quarterly and this particular issue contained 12 pages of nothing but work accidents in the water and wastewater industry which occurred mostly due to unsafe working conditions. Injuries and deaths are occurring around our country and it would be nice to keep Montana out of this particular publication.

I have also included an article (Atlanta Constitution - Atlanta, GA 6/6/87) on a ditch cave-in taken from the same bulletin. This may keep some of you out of those unsafe trenches!

# POISONOUS GAS KILLS 2

*Employees of NMB die in manhole*

NORTH MYRTLE BEACH-

Poisonous gas fumes killed two city employees Tuesday, including the city's top public works official who climbed down a manhole to try to save his co-worker.

Both men collapsed at the bottom of an 8-foot-deep manhole at the Crescent Beach wastewater treatment plant at about 11:30 a.m.

Mike Singleton, 27, was dead at the scene; Public Works Director Bob Alford, 38 died at 12:40 p.m. at Grand Strand General Hospital.

A third employee, Ralph Norris, was treated for inhalation of toxic gas and released from Grand Strand Hospital Tuesday afternoon.

the Occupational Safety and Health Administration will investigate to determine if state regulations were violated.

A gas called hydrogen sulfide, formed naturally in wastewater treatment plants, is believed to have caused the deaths.

City officials say the Crescent Beach plant had been operating fine until a month ago, when ammonia levels exceeded those set by the Environmental Protection Agency.

Tuesday morning, Singleton was taking wastewater samples inside the manhole to determine what was wrong with the plant.

Alford heard a splash and went down to help Singleton, who had collapsed.

Norris followed Alford and was climbing down the manhole to try to save the men when Alford yelled, "Get out, get out quick," city manager Bill Moss said.

In search of help, Norris ran to co-worker Steve Halastala, who was driving a tractor nearby. Halastala got an air tank from a storage shack 100 yards away and tried to go down the manhole.

The rescue attempt failed when an air line on the tank was broken when it hit the side of the 3 foot wide manhole.

Steve Purington, wells and lifts supervisor, was on the scene minutes after Alford and Singleton collapsed.

"We had no way to get them out," Purington said. "It was just a hopeless situation."

Purington stood above the manhole awaiting rescue squads. He could only watch as the two men lay at the bottom.

He could see Alford's face. Singleton was face-down.

"It looked like they were asleep," he said.

Flags flew at half-mast on the front lawn of City Hall. Inside, employees somberly went on with daily tasks.

Chief Building Inspector Don Ray had worked closely with Alford, as the two consulted daily on building projects.

"He wasn't a typical city bureaucrat," Ray said. "Ten minutes after you talked to him, you felt comfortable...it's going to be a terrible loss."

Ray said he and Alford liked to smoke cigarettes together, especially during high-pressure meetings.

"We joked about smoking - that it was going to kill us."

He was described as a department head who would rather work in the field with his men than sit behind a desk. For fun, Alford started surfing this summer, and planned to surf after work Tuesday.

At a news conference, Moss' voice choked with emotion as he spoke about his co-workers and friends. He broke down and turned away from cameras while describing Alford.

Alford knew of the danger when he went down the hole, Moss said, but he went down anyway.

"He was just trying to help," Moss said. "He was that type of person."

Alford, Singleton and Norris were three of the most qualified public works employees in the city and considered experts with wastewater treatment, Moss said. Last week, Alford received training in the use of air tanks.

Singleton, of Conway, was described by co-workers as easy-going and sure of his job.

"He was serious-minded when it came to his job," said Sylvia Crisp, secretary for the public works department. She added that he also had a good sense of humor.

"On a bad day, he always found something to laugh about."

Singleton joined the city in January 1985.

Mayor Dick Hester called their actions "heroic" and said the incident showed the dedication of city employees.

# FATAL CAVE-IN DRAWS FINES OF $162,400

*Penalties against 2 firms stiffest ever in Georgia*

The stiffest penalties ever issued in Georgia for trenching safety violations - a total of $162,400 - have been leveled against two construction firms, officials of the Occupational Safety and Health Administration (OSHA) announced Friday.

Cited were Foster and Cooper Inc. of Atlanta and R.J. Davis Contracting Co. of Liburn for violations stemming from a Feb. 3 fatal cave-in at Lake Lanier Island Water Park in Hall County. Michael Worrell, 25, of Suwanee was killed in the accident when he was trapped beneath a 20-foot wall of dirt that collapsed while a work crew was laying a new sewer line.

Each of the two companies were charged $80,000 for 10 alleged willful violations of OSHA safety standards, which carry a maximum penalty of $10,000 apiece. Violations included improper shoring and sloping of trench walls, not providing trench boxes and piling soil too close to the edge of the trench, increasing the risk of a cave-in.

The firms also were found to be in non-compliance with codes covering trench exit ladders, use of hard hats, safety training for workers and precautions for working in previously disturbed soil, according to state OSHA Director Lee Camp.

Foster and Cooper, the prime contractor on the job, also was charged with two "serious" offenses carrying fines totaling an additional $1,600. R. J. Davis was charged with one "serious" violation and fined another $800.

The two companies were found to have violated OSHA trenching safety standards at two different locations at the work site on Jan. 30 and Feb. 3, resulting in double willful violation penalties, said Camp.

Camp said that the fines were the highest ever imposed in Georgia, and perhaps the Southeast, for trenching violations.

"This was one of the worst trenching violation cases we've seen in a while. There were a number of willful violations," said Camp.

"This is an unprecedented fine. We don't know why it is so heavy. It is unjustified," said Charles Foster, vice president of Foster and Cooper. Foster said his company already had filed for an appeals hearing.

Mrs. R. J. Davis said Friday neither she nor her husband would comment on the fines.

Neither company had previous histories of trench safety violations, said Camp.

The OSHA director said he hoped that such high penalties would make other employers realize what can happen to them if they are found in violation of OSHA standards, and that they will provide for proper safeguards at work sites.

OSHA is beefing up its safety compliance office with the addition of five officers this month to monitor construction sites throughout the state, said Camp. That would bring the number of inspectors to 20, he said.

OSHA can level fines of up to $10,000 in cases in which the employer knowingly violates safety standards or is aware that a hazardous condition exists. Serious violations, carrying maximum fines of $1,000, are cited when there is "substantial probability" that death or serious physical harm could result from a hazard the employer knew about or should have known about, said U.S. Department of Labor Spokesman Dan Fuqua.

# CAN I INTEREST YOU IN A SLUDGE-SICLE?

By: Craig Brawner, Water Quality Bureau

While sludge-sicles are probably not going to be a real big seller, the conditioning benefit of freezing sludge has been recognized for many years. Freezing and then thawing a sludge will convert the previously jelly-like soup into a granular material which readily dewaters.

When sludge is frozen, the solid material in it compresses into individual conglomerants surrounded by frozen water. While thawing, the sludge drains rapidly through the large pores and channels formed by the frozen water. Cracks in the frozen mass also serve as drainage channels. The freeze/thaw phenomena works on any type of sludge, but is especially effective on chemical and biochemical sludges which are typically difficult to dewater, such as found at water and wastewater treatment facilities.

Experience in a number of locations has shown that the sludge solids concentration will approach 25 percent as soon as thawing is complete, and 50 to 70 percent solids can be achieved with minimal additional drying time. The thawed sludge also retains its porous character and will readily dewater again following precipitation events.

While this may not be news to many operators and other water and wastewater professionals, data has recently been published which provides definitive design information for reliably utilizing the freeze/thaw phenomena in sludge handling facility design and operation. The information should also provide operators with usable facts on the freeze/thaw process which can help them more fully take advantage of it's benefits.

Following are a few facts about the freeze/thaw process which must be recognized if you hope to maximize its use.

I. **The entire sludge layer must freeze completely to achieve the dewatering benefits; therefore, it is important the sludge be applied in shallow layers rather than in one deep layer.** The data indicates that a 3-inch layer is practical in most areas, though thicker layers are feasible in colder climates (9-in. Layers have been used in Duluth, MN). The applied layer depth should be adjusted for prevailing weather conditions. Hand probing with a small pick or axe is the easiest way to assure complete freezing has occurred prior to additional sludge applications. Sludge layer depth for your location can be estimated from the design manual referenced below and/or refined from experience.

II. **The maximum total depth of sludge which may be frozen for most of the state is roughly equal to the frost penetration depth in your area.** A more refined estimate can be made through the following calculation:

*Max. Sludge depth = [frost penetration (in inches) x 1.76] - 38*

The maximum freezable sludge depth varies in Montana from as little as 2 or 3 feet to over 7 feet. However, for most existing facilities in operation in the state, the maximum depth will be limited by the side wall height of the facility's existing drying beds. For facilities with inadequate winter storage, raising sidewall height of the drying beds may be an effective way to obtain the needed winter storage without sacrificing subsequent dewatering time.

III. **The maximum total depth of sludge which is frozen must be limited to a depth which will thaw within a reasonable time during the summer.** To optimize summertime drying bed use, only the amount of sludge that can be removed by about mid-May should be applied for freezing. However, this should not be a significant limiting factor for most areas in Montana. The time required to thaw a particular frozen depth of sludge can be calculated using the manual referenced below.

IV. Heavy snow fall acts as an insulating barrier retarding the sludge freezing rate. **Snow layers greater than 3 inches should be removed from the sludge surface to assure maximum freeze potential.**

V. Chinook weather or rainfall may occur during the freezing stages. **Additional sludge application should not be made until surface water has completely drained or refrozen.**

VI. **The sludge feed piping to the drying bed must be designed to apply each layer of sludge on top of the previously applied and frozen layers.** Therefore, if you intend to apply a total of 4 feet of sludge (in several layers), the discharge piping must be high enough to allow this. Sludge application procedures and facility design must provide adequate freeze protection for the sludge feed piping.

VII. **Pathogen kill is not improved during the freeze/thaw process.**

By considering the above information in developing your wintertime solids handling routine, perhaps you can turn "old man winter" from an operations adversary to a sludge conditioning ally.

Additional information on sludge dewatering can be found in EPA's Design Manual - Dewatering Municipal Wastewater Sludges (EPA/625/1-87/014 September 1987), available from Ord Publications, P.O. Box 12505, Cincinnati, OH, 45212.

TO: All examinees for the March 12 examination

FROM: Certification office for Water/Wastewater Operators

SUBJECT: Special math review for examinations

There will be a special math review for all examinees the evening before the March 12 examinations in each of the communities where the examinations will be held. All those who register for the examinations will be notified of the time and place for this math review.

# MONTANA WATER POLLUTION CONTROL ASSOCIATION

By: Jan Cranor - President, MWPCA
Joe Steiner - Federation Director, MWPCA

Just what is the Montana Water Pollution Control Association (MWPCA)? We have all heard of the organization and many of us have been members of the association for numerous years but the Montana Association has been overshadowed by its tie to the national Water Pollution Control Federation (WPCF).

Continually trying to meet the needs of its members, the WPCF is making great strides in expanding their field of service while maintaining their "commitment to basic water issues". This is evidenced by the services being offered through the Professional Wastewater Operations Division. Such services include the addition of The Bench Sheet as a service to laboratory personnel, water quality education programs being developed for youth education, toxic and hazardous waste education and numerous other endeavors that can be utilized by federation/association members. All of these programs can be of considerable assistance to Montana members if they take the time to recognize and research the vast resource we have in the Federation.

So, with such a strong and changing national "Big Daddy" to carry the Montana Association along, what is the reason for our existence? What changes have we made in the association and what can we do as an association for our members and the public?

The MWPCA has made some changes in the past few years. Among them were a reorganization of officer responsibilities and the establishment of a director position for the operations division. We have somewhat strengthened our efforts with the joint education committee and continue to co-sponsor two scholarship funds. Also, the conferences have improved in the past years through our efforts in the joint Host City and Program Committees. However, despite these changes and improvements, the MWPCA exists from one conference to the next without a defined purpose and with very little effort from most of the membership.

Is this what we want to do? Should we do more? Should we do less? We have struggled with these questions for years. It is very easy to just let the questions remain unanswered because the association will "survive". However, we want more than just survival.

It is our intent to propose to the Association members at the meeting in March, a "long range plan" to give our officers and members some direct goals and objectives. Recognizing that we are following along on the heels of the national WPCF, we feel that a positive direction is needed for the Association. Education, both entry level (basic) and continuing, is an area we can specialize in and has in the past been very important to the association members. Our intent is to construct a simple, Montana oriented plan focusing on the education of our members and the public. The objective of the Association shall remain as stated in our constitution; however, our mission shall be outlined and simplified. We have to recognize that with the

*size of our organization, our goals have to match our resources both in time and number of members. If this is our direction and we all agree, then the Association must totally commit our resources and efforts in that direction.*

*We ask that everyone plan on participating in the Conference in Helena and provide us with your assistance in establishing a direction for our association.*

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# A MESSAGE FROM THE DIRECTOR OF THE MSAWWA

Ralph Dunahoo, City of Conrad

1987 has left us with many things to consider in the treatment and management of our drinking water.

1) Rules and regulations are being mandated by our federal governments' own Environmental Protection Agency for the monitoring of 40 contaminants beginning June 19, 1988, and 34 additional contaminants not later than June 19, 1989. Cost of the testing will be expensive to all water systems.

2) Public water systems must notify their customers and users of a possible lead hazard in drinking water and assume the responsibility of providing a safe water to the tap. As of this date, EPA has not moved from their position that the water supplier is responsible up to the household tap. "Bill stuffers" are available through AWWA for customer notification.

3) The maximum contaminant level for lead may change from 50 micrograms per liter to 20. This will require additional treatment for some water suppliers.

4) Keep abreast of the water rights issue; this will be an important item in the months to come. It may take years to settle. All water systems will feel its results; surface and ground water suppliers alike.

5) Have you reported your chemical inventory to the local Disaster and Emergency Services Coordinator? Chlorine, alum, weed sprays etc. must be reported.

All the items I have mentioned will cost dollar's but who pays? The consumer of course! Don't look for much outside funding in 1988 and don't expect any federal windfalls.

Don't forget National Drinking Water Week, May 2-8, 1988.

See you at the annual meeting. Plan to attend; you'll be glad you did!

# GOOD NEWS FROM THE FLATHEAD

By: Craig J. Hess and Jennifer Lewis
Flathead Basin Commission

Recent data from two of the four major sewage treatment facilities that are upstream from Flathead Lake, reflect results of the phosphorus detergent ban. Since December 6, 1986, in Flathead County and since January 1, 1987, in Lake County, consumers have been unable to purchase laundry detergents and cleaning compounds containing phosphorus.

Columbia Falls Public Works Superintendent, George Wilson, reports the effluent from the Columbia Falls Sewage Treatment Plant contains approximately 2.0 mg/l less phosphorus than before the ban, for a 27% reduction. "Before the ban," Wilson said, "the effluent was never under 7.0 mg/l and usually 7.5 mg/l. Now the effluent is running between 5.3 to 5.7 mg/l phosphorus."...

So reported the opening paragraphs of a press release from the Flathead Basin Commission last October.

Flathead Lake, the largest natural freshwater lake in the western United States, is known for its crystal clear water. It remains one of the last great watersheds in North America. Over the last 20 years the water quality of Flathead Lake and other lakes in the Basin has declined measurably due to nutrient loading.

The appearance of blue-green algae blooms in 1983 signaled the vulnerability of Flathead Lake water quality. The growth of algae is in response to increases in nutrients that enter the waters from a variety of manmade and natural sources. The increase in algae growth is an indication of lake eutrophication, a Greek word meaning "to nourish well."

Although nutrient dynamics is a complex topic, the biological limiting factor in Flathead area waters is the nutrient phosphorus. The addition or removal of even small amounts of phosphorus can greatly impact water quality. Failure to reduce these impacts threatens the social and economic health of the entire area as well as having dramatic consequences on fish and water quality.

In 1984, the Water Quality Bureau of the Montana Department of Health and Environmental Sciences implemented the Strategy For Limiting Phosphorus in Flathead Lake. The Strategy is comprehensive and attempts to reduce phosphorus pollution from all its sources within the Basin. The six part Strategy includes:

1. Imposing a 1.0 mg/l effluent limit on phosphorus from all sewage treatment plants discharging into Flathead Lake, or its tributaries.

2. Developing wastewater management plans for unsewered communities in the Basin.

3. The use of only low-phosphorus or phosphorus-free laundry detergents and cleaning compounds.

4. Strengthening controls on non-point sources of pollution.

5. Strengthening land use controls from development impacts on sensitive soils in flood plains and in shoreline areas.

6. Implementing and refining the Water Quality Monitoring Program, coordinated by the Flathead Basin Commission.

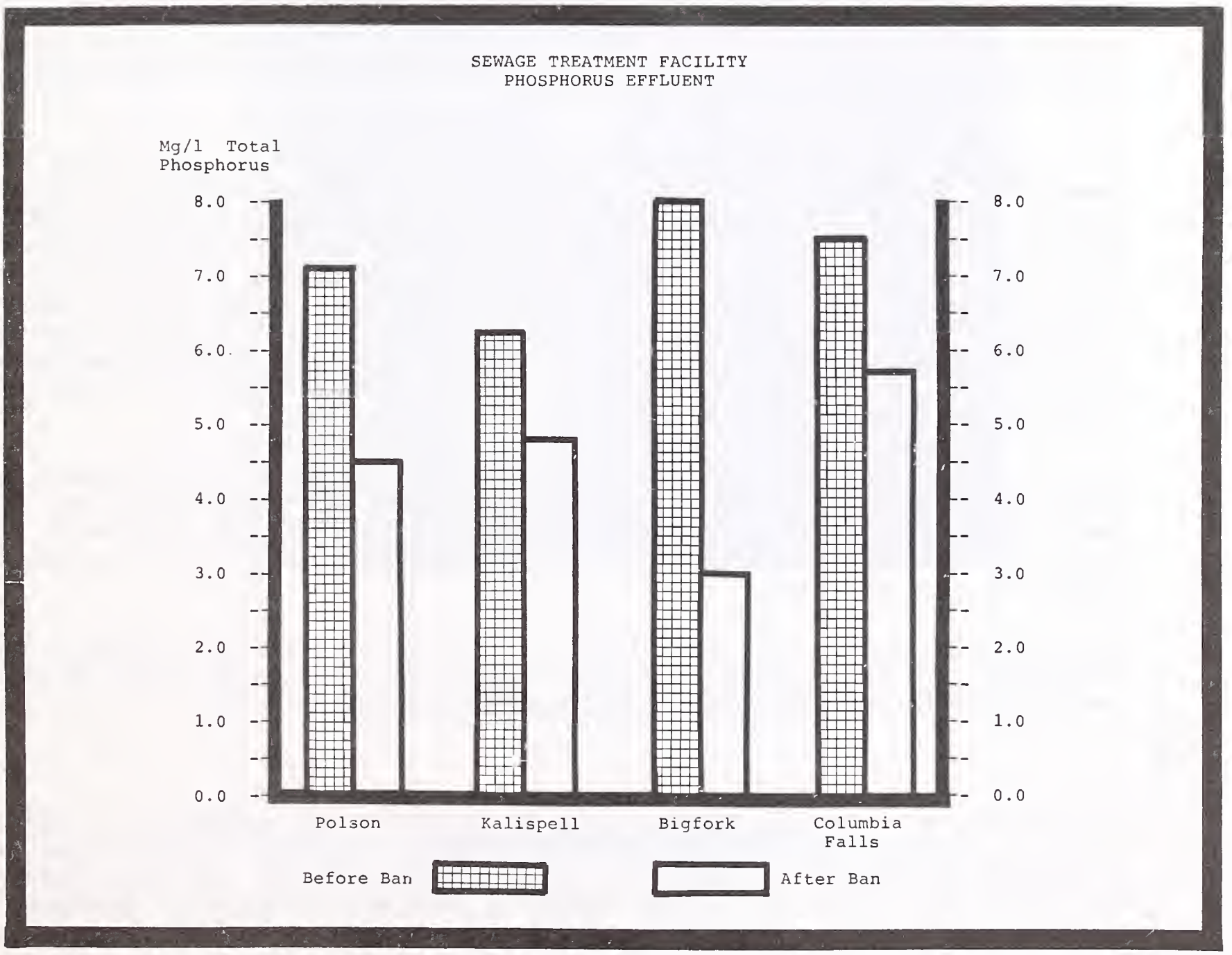
As part of this Strategy (number 3 above) the Flathead Basin Commission along with many citizens, law makers and interest groups recommended banning the sale of high-phosphate detergents. As a result, the 1985 Montana Legislature

*passed House Bill 711, which allows Montana counties to adopt a model rule banning all high-phosphate detergents. Since the beginning of 1987, in Lake and Flathead Counties, laundry detergents and cleaning compounds containing phosphorus are no longer available.*

*The results of the detergent ban are reflected in the effluent quality of the sewage treatment facilities in the Basin. (Refer to graph) All plants exhibited a reduction of phosphorus ranging from a 3.0 mg/l reduction in Polson, to a 1.5 mg/l reduction in Kalispell. It has been calculated that this 25% or greater reduction is the equivalent of five metric ton per year less phosphorus that is no longer reaching surface waters from sewage treatment plants and septic systems.*

*When asked to comment about the immediate effect this nutrient removal will have on Flathead Lake, Dr. Rick Hauer, limnologist from the University of Montana Flathead Lake Biological Station, made some comparisons. "Flathead Lake is like an overweight person who needs to go on a diet. We may have eliminated the chocolate cake but all items on the menu need to be reduced."*

*Other elements of the Phosphorus Reduction Strategy are indeed being implemented and include tertiary sewage treatment to remove even more phosphorus. All of this represents good news to Basin residents who overwhelmingly supported the phosphorus detergent ban and other efforts to improve water quality. Through actions of interested citizens, government officials, sewage treatment plant operators, and others, Flathead Lake may at least be on the right road to a long and healthy life.*



# RECOGNITION OF A DEDICATED OPERATOR:

## TOM BARR - GORE HILL WATER DISTRICT

*By: Denise Ingman, Water Quality Bureau*

*Tom Barr has been the operator of the Gore Hill Water District, located on the bluffs just south of Great Falls, since March of 1982. The district obtains it's water from two deep wells and currently has 180 service connections.*

*At the time Tom took over the responsibility of operating the system, the district was in pretty tough shape. Until that time, the day-to-day operation and maintenance of the system was done on a volunteer basis and communication between volunteers was not the best. Most of the work was done on weekends or late at night. Needless to say, many misunderstandings occurred and the turnover of board members was tremendous.*

*With Tom on board, this type of operation did not continue. He tackled a long list of deficiencies and before long the system was taking shape. He was responsible for renovating the booster pumping stations, installing chlorination facilities, providing well head protection and rebuilding a water storage facility. He also designed and implemented a system of preventative maintenance and record-keeping that would be beneficial to all water systems around the state.*

*Tom began conducting the required chlorine monitoring on a daily basis and inadequate residuals were detected and corrected before contamination became a problem. The results were recorded for permanent records and also submitted to this office as required by law. Because the source of water for the district contains iron and manganese, special measures were instigated to make the water as palatable as possible, including a regular flushing program and regular cleaning of the two storage reservoirs. When faced with the problem of how to thoroughly clean the reservoirs of the 4 to 6 inches of iron and manganese precipitate that accumulates every 6 months, Tom designed and built an underwater vacuum expressly for this purpose.*

*Tom has also been responsible for improved communication within the governing board of the District. Tom "calls 'em as he sees 'em" - always letting the board members know if problems have occurred and together they work on solutions. Money is always tight, but through good planning and volunteer labor, the work gets done.*

*Tom actively attends and participates in continuing education seminars for operators. He willingly wrote an article for the Spring 1987 issue of this newsletter entitled "So You Want to Upgrade Your System."*

*Tom was born at Clark AFB in the Philippine Islands as his father was a fighter pilot in the military. Tom was educated overseas, attending school in Berlin and Munich and graduating from high school in Paris, France. He then returned to the United States for college where he received a degree in Mechanical Engineering from Texas A&M. Tom married while in college in 1957 and entered*

*the service after graduating in 1959. He and his wife Gladys eventually had three daughters and lived in several areas of the U.S. during the course of their career with the military, including Mississippi, California, Nebraska, and Malmstrom AFB in Great Falls, Montana where Tom retired in 1979.*

*Following retirement, Tom attended the Colorado School of Trades in Denver and completed a course in gunsmithing. He owned and operated a gunsmithing shop in Great Falls for 2 years but was forced to close due to the problems encountered with liability insurance. Now he does the work as a hobby or as a favor to friends. Tom also enjoys snowmobiling, camping, motorcycling, and he loves to hunt.*

*Tom, all of us at the Water Quality Bureau and your fellow professionals in the water and wastewater industry would like you to know that we appreciate the hard work, worry, and many hours you donate to your water district. When visiting your system and seeing first-hand all the improvements that have been made, it is clearly evident that you are both dedicated and conscientious. Please know that your contributions have not gone unrecognized. Thanks for a job well done!!*

*Tom shown here with the rewards of a duck hunting expedition*

# T & P Valves - A Different "Cross-Connection Problem"

*By: Denny Lopp*
*Assistant Water Superintendent*
*Modern Electric Water Company*
*Spokane, WA*

*Mr. Lopp is the director of the Northwest & Alaska Region of the American Backflow Prevention Association. He also serves as an instructor for cross-connection control programs throughout Washington state, and is on the AWWA Pacific Northwest Cross-Connection Control Committee. He has been involved in several revisions of the Pacific Northwest AWWA Cross-Connection Control Manual.*

*Reprinted with Permission - Backflow Prevention Magazine: March 1986 Issue.*

What do temperature and pressure relieve valves (commonly called T & P valves) have to do with cross-connection control? Thermal expansion, that is, the expansion of water when it is heated, is a normal occurrence in hot water heaters and hot water heating systems. When the water expands, however, where does it go? Usually the hot water is forced back into the feed lines, and no problem is evident, although this type of backflow may cause problems. When backflow preventers are installed on the service line to a facility/residence or supply line to a hot water heater, the area where thermal expansion can occur is reduced.

T & P valves are generally installed on hot water heaters to relieve excess pressure that may occur in the heater. The T & P valves may momentarily open and discharge water whenever the water pressure in the consumer's system exceeds the pressure setting of the T & P valve. This nuisance problem can be corrected by the installation of a thermal expansion tank. A more serious problem may result if the hot water heater should overheat. The combination of reduced thermal expansion area and a T & P valve that does not open (or where no T & P valve has been installed) increases the possibility that the hot water heater may explode. An overheated hot water heater than cannot vent to atmosphere may explode whether thermal expansion is reduced or not.

The responsibility for T & P valve inspection and reinspection is normally vested to the plumbing inspectors and does not come under the jurisdiction of the water purveyor. Since the problems posed by T & P valves may be magnified by the installation of backflow prevention devices, however, cross-connection control classes in Washington stress that T & P valves be inspected when a device is installed. The valve must be properly installed, sized and capable of discharging to atmosphere. The consumer must also be educated regarding the importance of the operation and reinspection of T & P valves.

The following is a brief synopsis of the purpose and operation of the T & P valve.

The temperature portion of the T & P valve is designed to open and vent to atmosphere whenever water within the heater reaches approximately 210° F. Most hot water heater thermostats are set about 130° F. However, if a thermostat sticks (won't shut off), the temperature of the water can increase. Once the water temperature reaches approximately 210° F, the T & P valve will open and vent the hot water to atmosphere, allowing cooler water to enter the heater. Venting will continue until the water temperature is reduced below 210° F. If the T & P valve is the fuse-plug type, it will vent until the water supply to the tank is shut off and the valve is replaced.

If the water temperature increases to more than 212° F, the water within the tank is referred to as superheated. If the superheated water is suddenly exposed to atmosphere, it instantly flashes into steam and a violent reaction may result. Superheated water expands approximately 1700:1. If a person should open a water faucet during this condition, steam, rather than water, may come out, which could result in injury.

A more serious situation can occur if a hot water heater containing superheated water should suddenly rupture, resulting in an explosion. As an example, if the water in a 30-gallon hot water heater is heated to 297° F at 50 psi, and it suddenly ruptures, the energy liberated is equal to 1 lb of nitroglycerin - over 2,000,000 ft lbs of energy (1 ft lb is the amount of energy required to move a one pound mass one foot with no resistance). Thus, it is essential to keep the water temperature in hot water heaters below 212° F.

The pressure portion of the T & P valve is designed to open and vent to atmosphere whenever water pressure within the hot water heater exceeds the pressure setting on the valve. These are normally pre-set at 125 psi or 150 psi, which is above normal supply pressure. However, water pressure may increase due to thermal expansion or water hammer, which causes the valve to open and vent to the atmosphere. A pressure-only relief valve will not provide protection for excessive water temperature.

The valve must be installed so the probe of the valve will be submerged in the water within the heater. If the valve is not installed directly in the top of the heater, it should be in a tee in the hot water outlet line within six inches of the heater. This is necessary to prevent thermal lag. These valves must never be installed in the cold water supply line to the heater.

Correct sizing of a T & P valve is important to assure the valve is capable of discharging the overheated water at least at the same rate as the heater is capable of generating. Most T & P valves sold today for residential hot water heaters are adequately sized.

T & P valve sizes are based on the following guidelines:

Electric water heaters - total watts of electricity (total watts of the elements) X 3.413 = BTU/hr

**Example 1**

4,500 watts (upper element) + 4,000 watts (lower element) = 8,500 watts x 3.413 = 29,010 BTU/hr

Gas water heaters - check the name plate of the heater for the total BTU/hr. The American Gas Association (A.G.A.) rating of the valve must exceed the total BTU/hr of the water heater. The A.G.A. rating is located on the tag of the T & P valve.

**Example 2**

A water heater rated at 34,000 BTU/hr must have a T & P valve rated at >34,000 BTU/hr

T & P valves should be inspected to ensure (1) that the valve is a T & P valve; (2) that the valve is properly installed; (3) that it is sized correctly; and (4) that is will discharge water when the operating lever is lifted (if so equipped).

Most plumbing authorities recommended that any valve over three years old based on the dating code be removed and visually inspected for accumulations of corrosion deposits and to ensure it has not been illegally altered or repaired. The valve should be replaced if there is evidence of any of the above. The age of the valve may be determined by locating the four-digit dating code on the name plate (e.g., 8322 was manufactured the 22nd week of 1983). A T & P valve should be manually operated by lifting the operating lever on a regular basis to ensure it is capable of discharging water.

In early 1985, a decision was made by Modern Electric Water Company (Spokane, WA) to prepare a brochure on T & P valves to acquaint its customers with these valves. The brochure covers the operation, installation, sizing and inspection of the valves. These were sent to all water and electric customers along with a survey card which the customers were asked to fill out and return.

Based on the survey cards returned, 25 percent of the hot water heaters were not properly protected. 18 percent had no T & P valve installed; 2 percent had incorrectly installed T & P valves; 4 percent were equipped with pressure-only relief valves; 1 percent of the T & P valves would not discharge; and less than 1 percent had plugged T & P valves. About 15 percent of the T & P valves would not discharge when inspected, bringing the actual number of unprotected and under-protected hot water heaters in the system to nearly 30 percent.

The T & P valve inspection program was fairly easy to implement in conjunction with the cross-connection control program. While inspections of this type are not normally considered a water supply responsibility, the program increased the visibility of the Modern Electric Water Company and provided a needed service to the community.

*For more information contact Denny Lopp, Modern Electric Water Company, P. O. Box 14008, Spokane, WA 99214.*

# PRACTICAL KINETICS

By: Gary Root, Columbia Falls

An early researcher in the field of microbiology by the name of Monad, attempted to explain the number of microorganisms present in a pure culture at any given time. He developed the following formula.

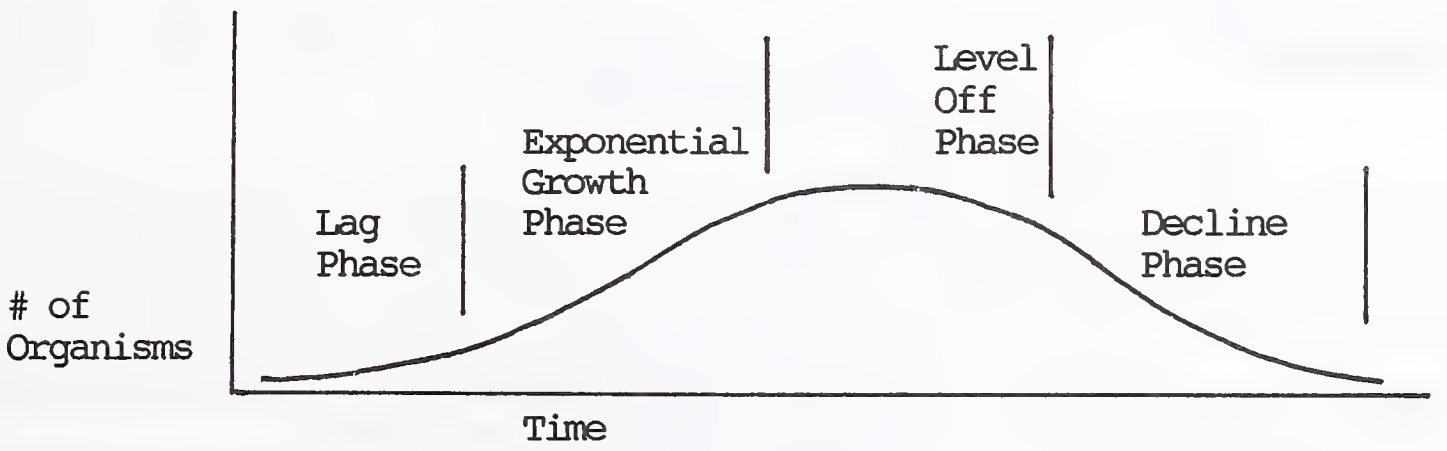
$$1/\theta = Y(F:M)-Kd$$

$\theta$ = mean cell residence time or sludge age
Y = yield coefficient
F:M = the ratio of food to the mass of microorganisms
Kd = the endogenous respiration coefficient

This is to say that for any given time, the number of microorganisms produced (Y) is determined by the ratio of food to microorganisms (F:M) minus the numbers that have died (Kd).

This formula basically describes what happens if a petri dish filled with a substrate is inoculated with a microorganism that is able to grow on the substrate. It takes into account the growth cycle of the microorganisms on the petri dish as is presented in **Figure 1**. The microorganisms have a lag phase where they become acclimatized; then growth begins and takes off exponentially until a point is reached when growth starts to level off because of the reduction of food and the accumulation of toxic waste products. After leveling off, a decline sets in until the eventual exhaustion of all food and then death occurs.

**Figure 1**




Monad's formula is often used as an approximation for wastewater treatment plant kinetics. However, several important factors must be recognized.

1) A treatment plant is not a pure culture of one microorganism. It is a mixture of many types.
2) Temperature, flow and industrial load vary in treatment plants.
3) A treatment plant is not a closed petri dish with a definite amount of food. Food is continually entering the system at the same time that effluent is removed and microorganisms (sludge) are being wasted.

A treatment plant is normally run at an optimum condition determined by either calculation, performance, or experience. In other words, the plant is run at a constant sludge age. The practice of wasting determines the sludge age. If one measured the mass of sludge held in the system and the mass of sludge wasted then the sludge age can be calculated by dividing the sludge inventory by the sludge wasted per day. For example:

MLSS in aeration basin = 2025 mg/l
Volume of aeration basin = .56 MG
Sludge Inventory = 2025 x 0.56 x 8.34 or 9457 pounds

If 4000 gallons is wasted each day at a concentration of 11,930 mg/l: 11930 x .004 x 8.34 = 395 pounds of sludge wasted. Therefore sludge age is:

9457 ÷ 395 or 24 days

If the influent BOD is 259 mg/l and the flow is .25 MG, the influent food is 259 x .25 x 8.34 or 590 pounds.

If the sludge inventory is 9457 pounds then F:M equals 590 ÷ 9457 or 0.057.

(The endogenous respiration coefficient (Kd) is usually small(<0.1) and can be neglected in the calculation. In conventional plants the sludge is not held long enough for kd to be a factor. In extended aeration plants, kd is measurable but small.)

For the Columbia Falls plant the following data was generated and used in the formula

Sludge Age ($\theta$) = 31 days, so $1/\theta = 1/31 = .032$
F:M = .070 (This says it is an extended aeration plant.
Conventional plants would have a F:M of about 0.5)
$Kd \simeq 0$

Therefore:

$1/O = Y(F:M) - Kd$
$1/31 = .032 = Y(.070)-Kd$

$.032 = Y(.070)$
$Y = .46$

The Yield coefficient (Y) says that for every pound of influent BOD removed, 0.46 or approximately 1/2 pound of sludge was produced.

Another way to determine the Yield Coefficient is to calculate the yearly total influent BOD load. This is determined by obtaining the yearly flow from the flowmeter and multiplying it by the yearly average influent BOD and 8.34. As an example the following was calculated from Columbia Falls data:

80.3 MG/year x 205 mg/l average BOD x 8.34 = 137,000 pounds of BOD/year

The pounds of sludge wasted in this same year was 84,000 pounds. Therefore the sludge yield was 84,000 ÷ 137,000 or 0.61 pounds for every pound of BOD removed. This number is reasonably close to the 0.46 calculated previously. Since .61 is a number that is calculated from real data, it should be substituted back into the formula and Kd can be calculated.

$$1/\Theta = Y(F:M) - Kd$$
$$.032 = .61(.070) - Kd$$
$$.011 = Kd$$

This Kd value agrees with most literature values, telling us that the Columbia Falls plant is generating numbers that are reasonably accurate, and can be used to predict many cost factors.

One of the purposes of a treatment plant is to intercept the influent BOD before it ends up in the environment and to convert it into a manageable substance, namely sludge. The lower the yield coefficient, the more efficient the plant is running. A myth that existed up until recently was that an extended aeration plant did not need to waste because all the influent BOD was converted to carbon dioxide and water. If this were true, the yield coefficient would be zero.

The yield coefficient can be used to predict sludge production over time. If plant data is collected 5 days a week, 260 sludge age data points are generated per year and a good yearly average sludge age ($\Theta$) can be calculated for your plant. In addition, if the BODs are done weekly, 52 data points are generated in a year which will give you a good yearly average for food coming into the plant. This data allows you to calculate a good yearly yield coefficient. A yearly yield coefficient can be used to predict chemical usage over time and enables you to budget for the amount of money necessary for final disposal of the sludge. The yield coefficient can be used to size digesters and storage basins in future expansions. A yearly calculation of the yield coefficient can also be very useful in calculating budgets and in comparing operating efficiencies.

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# *O & M EXCELLENCE AWARDS PROGRAM*

*In 1985, the U.S. Environmental Protection Agency announced the initiation of an annual national Operations and Maintenance Excellence Awards Program. Under this program, regional and national awards are presented to publicly owned wastewater treatment facilities in recognition of outstanding operation and maintenance (O & M) practices and compliance status.*

*There are presently six regional and national award categories: small, medium and large facilities using secondary and advanced treatment technologies. EPA plans to add a non-discharging facility category for the 1988 awards.*

*The awards program is intended to highlight effective local operation and maintenance programs and increase public awareness of wastewater treatment facility contributions to clean water. This new EPA program recognizes the commitment by local officials and plant personnel to maintaining and protecting the nation's environmental infrastructure.*

*If you are interested in nominating the wastewater treatment facility in your community for this award, please contact Dick Pedersen of the Water Quality Bureau at 444-2406.*

# HELENA RESPONDS TO A DIESEL SPILL

By: Mike Garrity, City of Helena
and Dick Pedersen, Water Quality Bureau

## INTRODUCTION

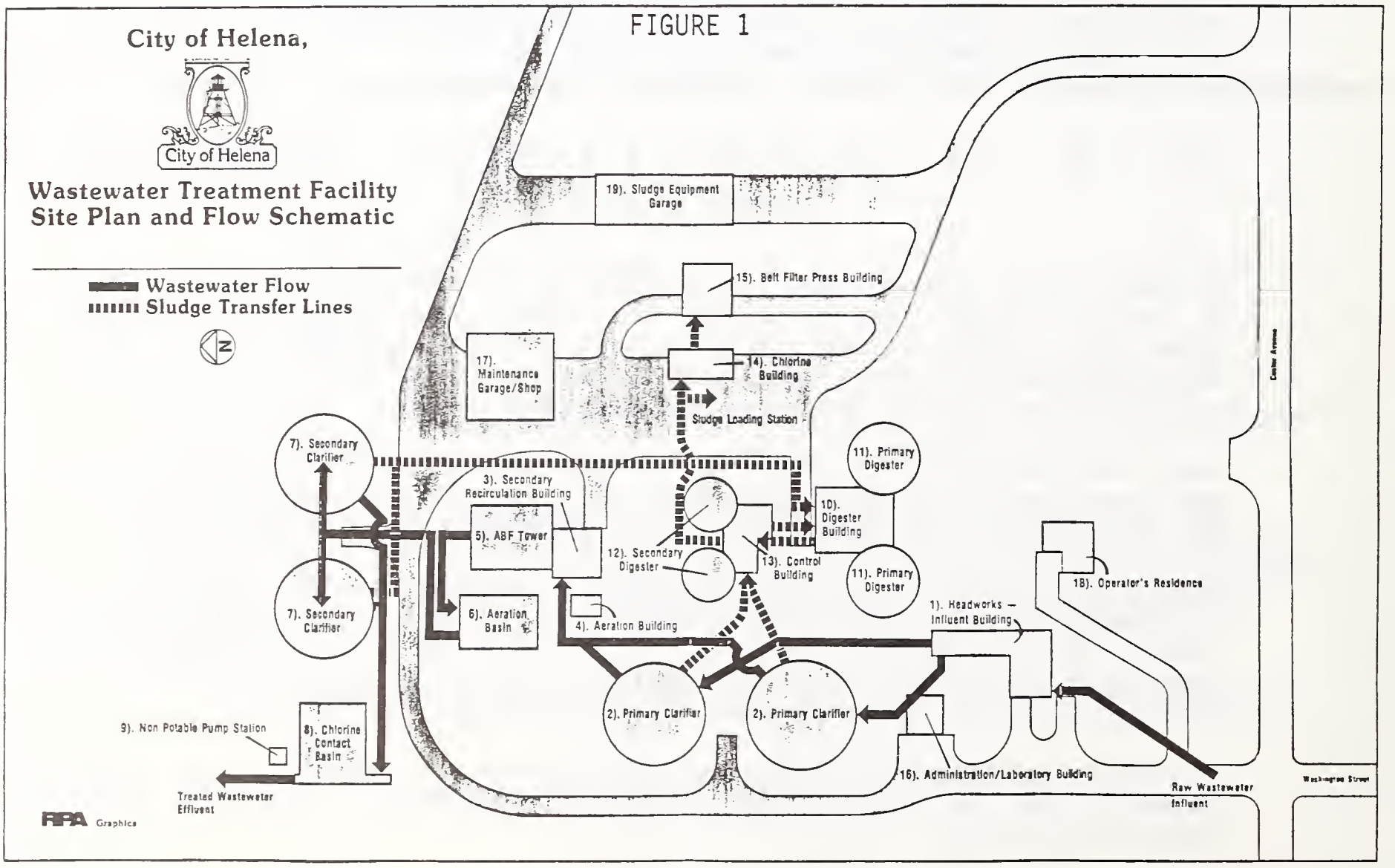
On Friday night August 7, 1987, 5,000 gallons of diesel fuel was spilled into the wastewater treatment facility at Helena, Montana. Although a spill of this magnitude has not occurred at many facilities, most operators have experienced spills of petroleum products. This article will summarize the spill event, explain what was done to mitigate the spill, and most importantly outline how communities can prepare for a similar spill of toxic material in to their wastewater system.

## THE HELENA FACILITY

The Helena Wastewater Treatment Plant is an activated bio-filter (ABF) type plant designed for an average daily flow of 6.0 mgd (see figure 1). The Helena plant includes the following unit processes:

1. Mechanical bar screen.
2. Aerated grit chamber.
3. Two primary clarifiers.
4. ABF stacked redwood media tower.
5. Aeration basin.
6. Two secondary clarifiers.
7. Chlorine contact basin.
8. Two primary anaerobic digesters.
9. Two secondary anaerobic digesters.
10. Centrifuge.
11. Belt filter press.

FIGURE 1



## THE INCIDENT

On Friday night a malfunction occurred at an industrial facility in the city. This malfunction allowed approximately 5,000 gallons of diesel fuel to flow into the city's sanitary sewer system over a 12 hour period. Wastewater officials discovered the diesel about 30 minutes after it started flowing into the treatment plant on Saturday morning. The Acting Superintendent of the facility dispatched a 3 member crew to attempt to locate the source of the diesel which was tracked down in about 30 minutes.

It was discovered that the interceptor line where the spill entered had a small blockage down stream of a slight sag in the line. The combination of the blockage and sag caused the diesel to build up during the nightly low flow condition. When the normal morning high peak flow entered the interceptor, it flushed all of the diesel to the wastewater plant.

Upon determining that the spill was significant and had the potential of affecting plant performance, the Acting Superintendent notified the following personnel: City Manager, Public Works Director, State Disaster and Emergency Services Division, State Water Quality Bureau, and local and headquarter representatives of the company responsible for the spill. Two individuals from Seattle, one from Missoula, and several local people representing the company were at the facility within four hours of notification to assist in clean-up efforts.

Shortly after the spill was discovered, both primary clarifiers were covered with 4 to 6 inches of diesel fuel. Fortunately the scum baffles in the primary clarifiers prevented most of the diesel from migrating downstream. Absorbent pads, which were available at the facility, were placed in the primary clarifier effluent channel to absorb fuel that was escaping the clarifiers. The entire work force at the wastewater plant and an individual from the city's street department were asked to contain and clean up the fuel.

It was decided that the best way to proceed was to aggressively work on the primary clarifiers. The employee from the city's street department was used to operate the street department's Vac-all. One primary clarifier was isolated and influent was diverted to the other clarifier. Using absorbent booms and a sea curtain in conjunction with the clarifier sweep arm, the diesel fuel was skimmed to a point the Vac-all could pick it up. The clarifier in use was cleaned up in approximately 7 hours. After completing this task the isolated clarifier was then cleaned up. All diesel and contaminated water removed from the clarifiers was transferred to a private septic haulers tank truck and hauled to a railroad tank car.

Although most of the diesel was contained in the primary clarifiers, some fuel did manage to migrate to downstream processes. Of most concern was the contamination of primary clarifier sludge. In order to minimize the effects the contaminated sludge would have on the entire digestion process, it was pumped to the west primary digester which then was isolated and closely monitored. Diesel fuel odors in the secondary part of the plant indicated some fuel did make it to other downstream processes.

## EFFECTS

In order to measure the effects the diesel was having on the system, monitoring primarily in the final effluent and digesters was increased . As can be seen in Table 1, secondary effluent BOD increased on August 9th. The weekly average values for BOD and

TSS the week following the spill were elevated but still below NPDES permit requirements. It was noticed by the operators that microbial counts in the secondary part of the plant were down by a factor of approximately 10 following the spill. This condition continued for 2 days.

The process most impacted by the spill was the digestion system. The data presented in Tables 1 and 2 demonstrates this. Methane gas production decreased significantly as did the kilowatts generated by the methane fired generator. In addition, the stress ratio (volatile acids divided by alkalinity) increased substantially in the west primary digester. It was felt that the methane producing bacteria were severely effected by the diesel. To induce recovery, uncontaminated sludge was fed to the west digester two days after it was isolated and then fed on alternate days thereafter. The digester showed complete recovery in approximately 7 days.

**TABLE 1**

DAILY VALVES

| DATE | EFFLUENT | | DIGESTER | | | |
|---|---|---|---|---|---|---|
| | | | Methane Gas Prod | KWA | Stress Ratio | |
| August | BOD | TSS | HCF | Gen | West | East |
| 1 | | | 468 | 1440 | | |
| 2 | 15 | 12 | 461 | 1480 | | |
| 3 | 14 | 8 | 389 | 1640 | | |
| 4 | 21 | 10 | 387 | 1240 | | |
| 5 | 20 | 9 | 410 | 1280 | | |
| 6 | 27 | 19 | 416 | 1120 | .104 | .126 |
| 7 | | | 467 | 1560 | | |
| 8 | | | 479 | 1920 | | |
| 9 | 34 | 20 | 338 | 800 | | |
| 10 | 26 | 20 | 322 | 1520 | .128 | .124 |
| 11 | 25 | 23 | 281 | 1400 | .128 | .095 |
| 12 | 22 | 25 | 350 | 920 | .149 | |
| 13 | 22 | 19 | 390 | 1640 | .133 | .092 |
| 14 | | | 381 | 1000 | .108 | .095 |

**TABLE 2**

WEEKLY AVERAGES

| DATE | EFFLUENT | | DIGESTER | | | |
|---|---|---|---|---|---|---|
| | | | Methane Gas Prod | KWA | Stress Ratio | |
| August | BOD | TSS | HCF | Gen | West | East |
| Week 1 | 19 | 12 | 428 | 1394 | .104 | .126 |
| Week 2 | 26 | 21 | 363 | 1314 | .129 | .102 |
| Week 3 | 17 | 20 | 438 | 1780 | .136 | .095 |
| Week 4 | | | | | .107 | .091 |

**SUMMARY**

From the time the spill was discovered until clean-up was complete took approximately 80 hours. The city's cost for their portion of the clean up was about $3,600. These expenditures were reimbursed by the party responsible for the spill.

An emergency contingency plan developed by city personnel prevented the diesel spill from having disastrous effects on Helena's wastewater treatment facility. Facility staff responded according to the plan and were able to quickly identify the source of the spill. Containment and clean-up proceeded rapidly, resulting in minimal effects on wastewater processes.

Helena's plan included the prior identification of potential sources of toxic material. Diesel was identified as a contaminant that could enter the system, therefore absorbent pads were stored at the facility. This preparation prevented more diesel from reaching the secondary system. The ability to quickly identify the responsible party led to their rapid response which was instrumental in cleaning up the spill. City personnel knew their function and what was expected of them in an emergency situation. This allowed for a smooth and effective response to the diesel spill.

Most communities may think developing an emergency contingency plan is last on their list of priorities. Hopefully, having knowledge of the Helena diesel spill will spur communities into developing an emergency contingency plan which could prevent a potential spill from becoming disastrous.

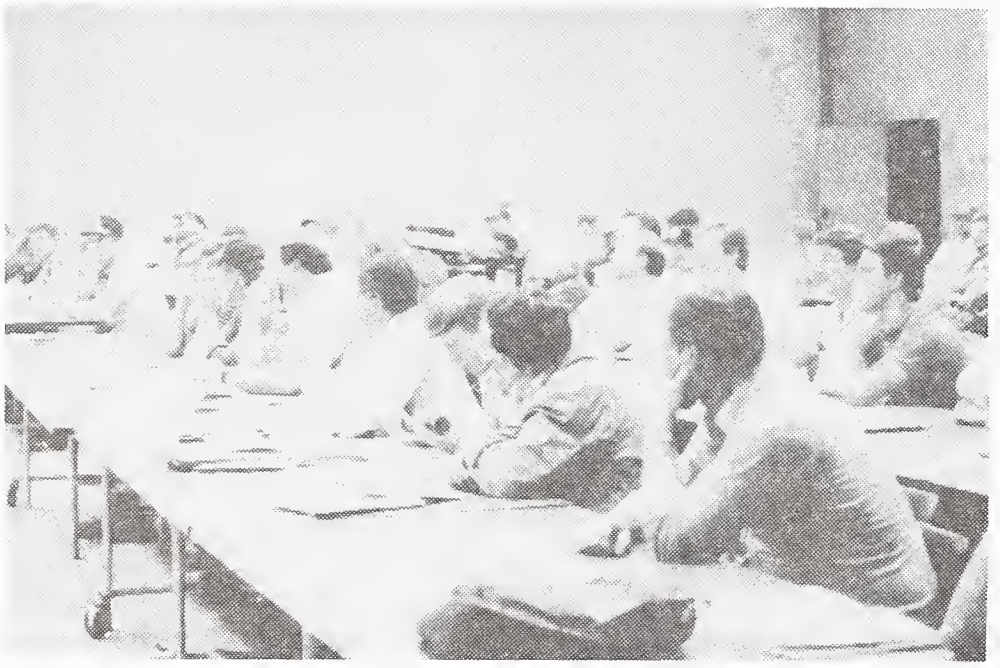
# 54TH ANNUAL OPERATORS SCHOOL

From Monday, September 14, 1987 through Thursday, September 17, 1987, 139 operators of water and wastewater treatment facilities attended the 54th Annual School for Water and Wastewater Operators and Managers at Bozeman.

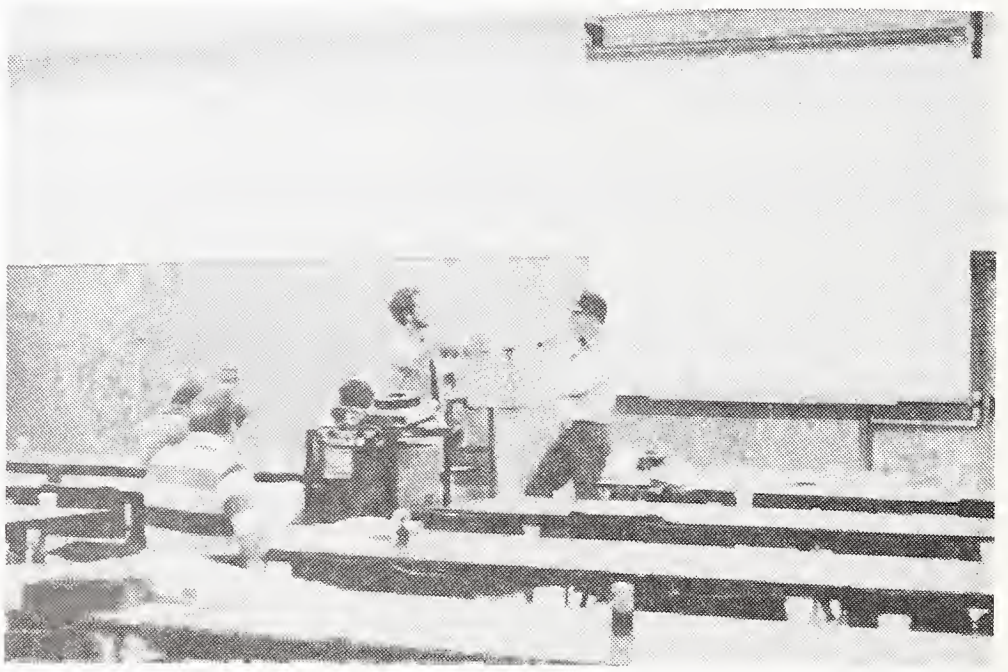
The school was, as always, a very busy time for all. We sincerely appreciate the excellent manner in which the operators conducted themselves. Without your participation and involvement the school would not be a success.

Full house

Scenes from the 54th Annual School for Water and Wastewater Operators and Managers.



Ballroom D



Actions speak louder than words.

Getting ready for the exam in our SOS session.

Rick Rosa of the Water Quality Bureau provides a little "one-on-one".

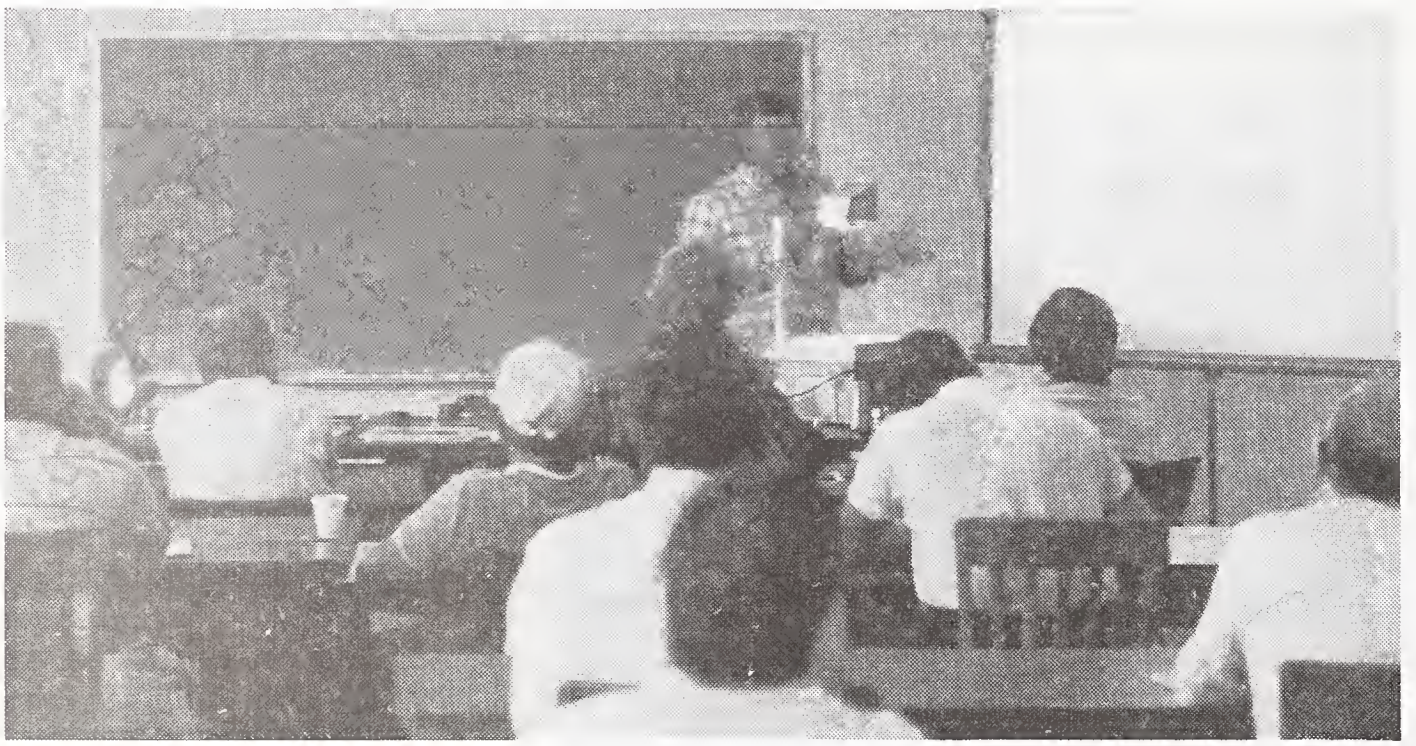
"Break time"

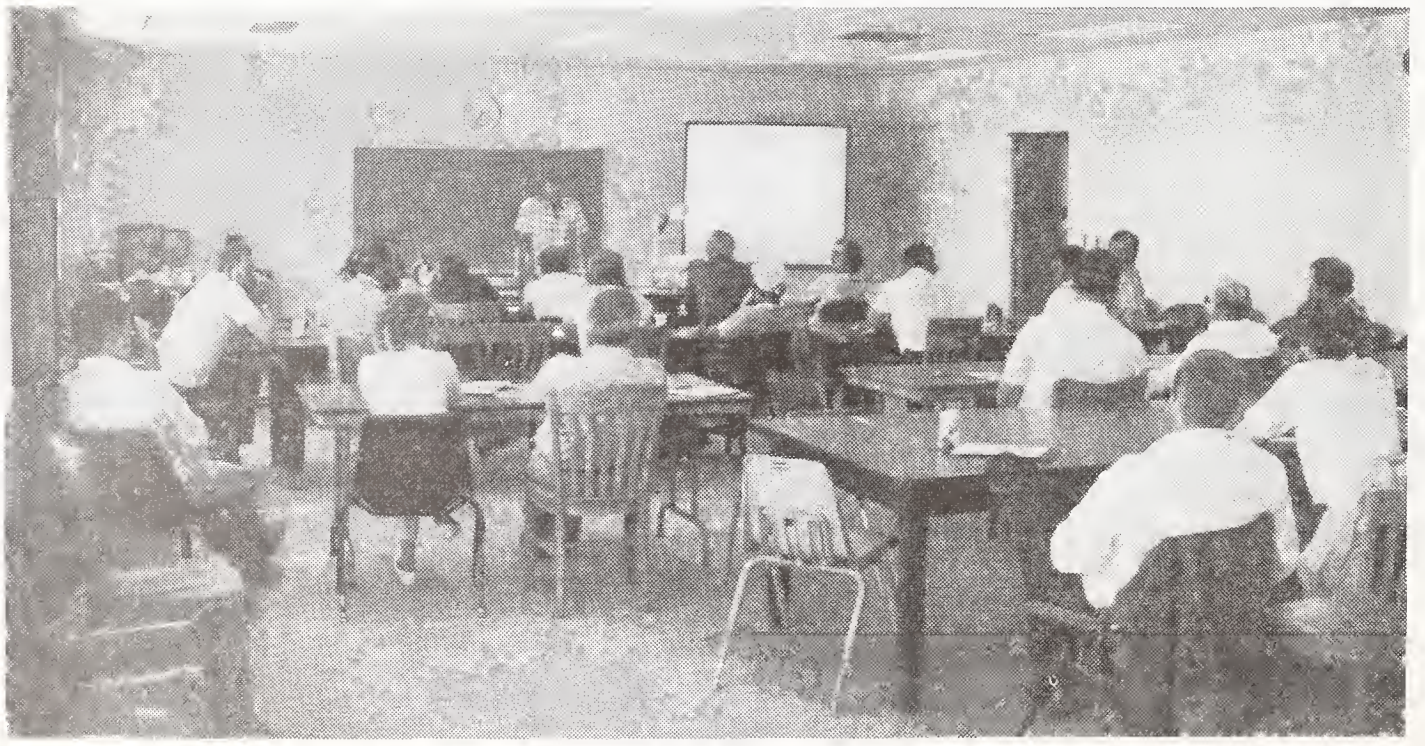
Tom Slovarp of the Water Quality Bureau discusses lagoon calculations in our SOS session.

Mark Richardson of Miles City tests Howard Peavy's wastewater simulator under the watchful eye of other operators.

# TRAINING - *A COOPERATIVE EFFORT*

Training seminars are being sponsored around the state by a number of organizations and sometimes they are co-sponsored. One such example was the Pumps, Seals, and Packing Seminar held in Helena in August and Missoula and Bigfork in October. The sessions were sponsored by the Water Quality Bureau and the Joint Education Committee of AWWA and MWPCA. Jim Duke of Montana Seals and Packing, Billings was the instructor. Jim has always been well received and operators continually request that his workshop be held in their area. Our hats are off to Jim for his excellent workshops and for supporting the Montana training program.





# Solving A Giardia Problem In A Small Treatment System

By: Michael R. Alberi, Steven J. Quall and Robert A. Kruse

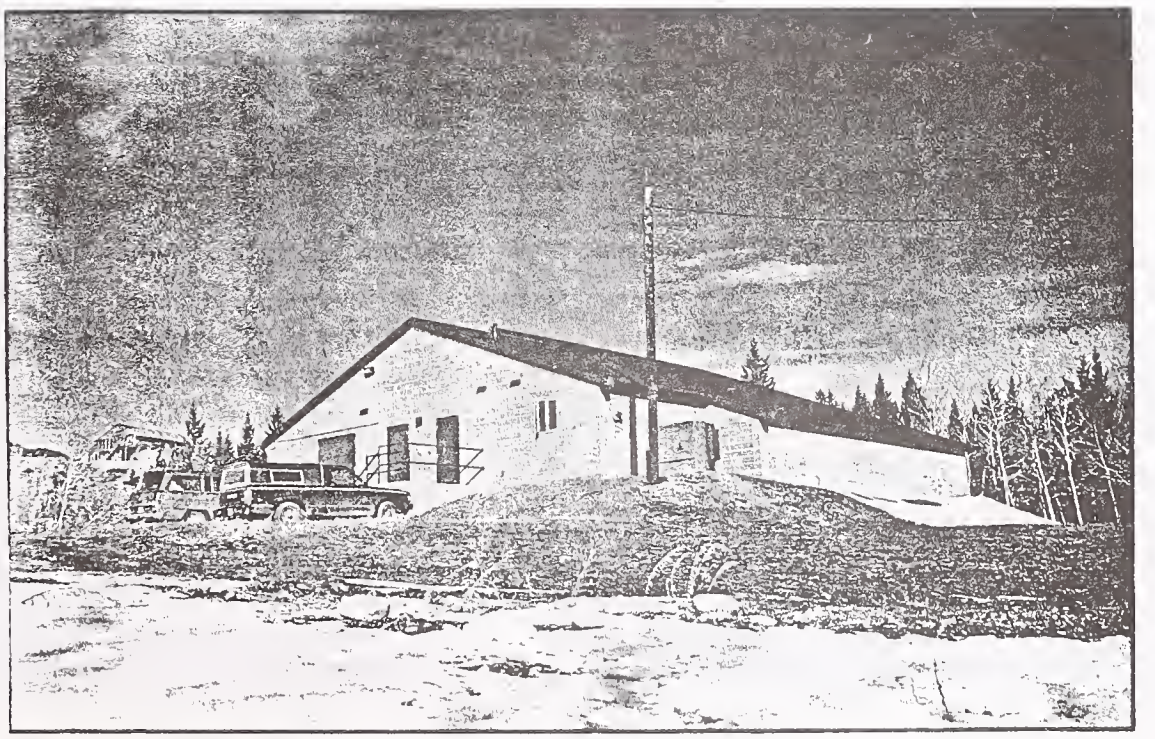
Reprinted With Permission - Water Engineering and Management: April, 1987

Outbreaks of Giardiasis continue to occur throughout the country despite the availability of water treatment technology that can remove the cysts. However, many of these outbreaks occur in small, rural communities that rely on surface water sources and that use basic water treatment facilities to produce potable water. When outbreaks occur, these communities face the dilemma of upgrading their system to protect public health without breaking the bank. One such Giardia outbreak occurred in the city of Red Lodge, Montana, a small resort community located at the base of the Beartooth Range of the Rockies.

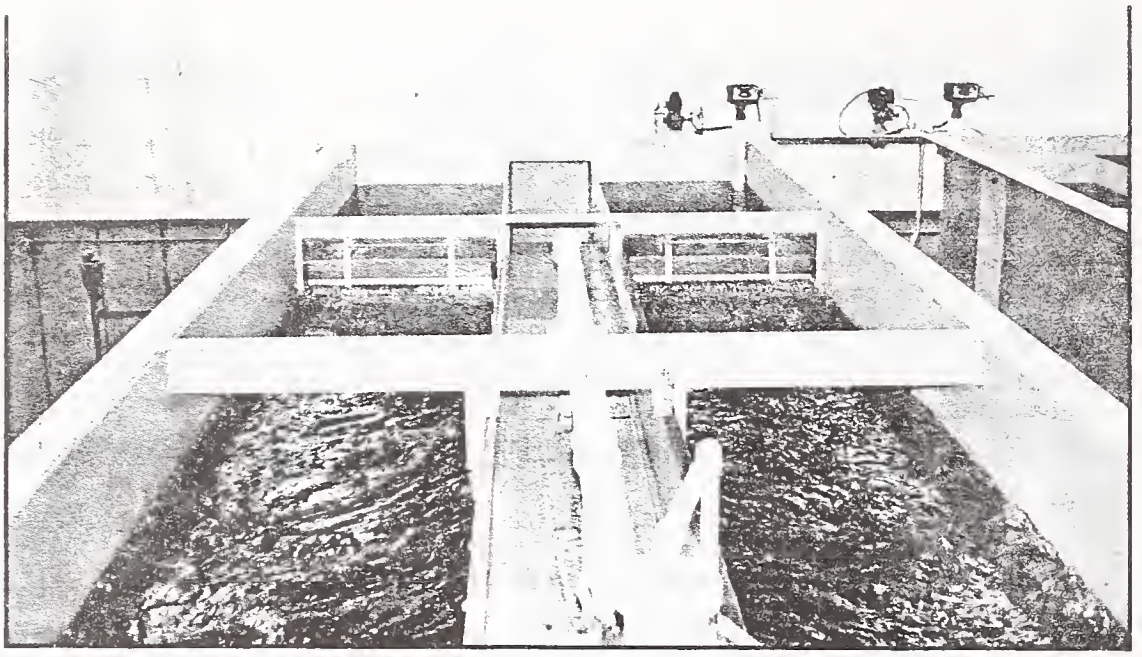
In the spring and summer of 1980, an outbreak of Giardia affected nearly half of the residents. Over the following year about 860 cases of Giardiasis were confirmed by local health officials. An initial investigation of the outbreak by the Emergency Response Team of the EPA and the Centers for Disease Control implicated the antiquated water system and untreated surface water source as the cause, although a sampling of the raw water did not produce cysts. New cases correlated with spikes of turbidity from the mountain stream serving as the supply source. Generally, confirmation of new cases lagged each rise in turbidity by the normally expected 6 to 22-day incubation period.

The existing water system consisted of a gravity supply; coarse-screened surface water intake, with a hydraulic elevation about 300 ft above the city; and a constant-rate chlorinator feeding water directly into the distribution system through two miles of transmission line.

Neither distribution system storage nor individual service water meters existed. This resulted in grossly excessive per capita use habits, high peaking factors, widely varying chlorine residuals in the



Red Lodge water treatment plant in Montana is site of Giardia removal process



Filter basins were key to solving Giardia problem

system, excessive service pressures in the lower end of the single service zone, and taste and odor problems in the fall caused by the action of chlorine on leaves taken into the system and deposited in the pipes. The system lacked the necessary barriers against waterborne, disease-causing agents.

Modifying the system to correct the situation presented two challenges. One was to develop an effective technical solution that precluded an occurrence of the Giardia problem. The second was to implement an economically sized system to serve present water users and a reasonable amount of growth. Since the system was currently unmetered, with customers using all the water they wanted, the city had to look at implementing system management changes and review financing options.

Before a comprehensive solution was developed, quick interim remedial actions were taken to assure that further outbreaks would be minimized. Flowpaced chlorination was added on the intake, and a boil-order was imposed for all enterprises servicing the public.

A master plan, which formed the basis for the design, construction, and financing of system improvements, was quickly developed. The plan's objectives were to provide treated water free from Giardia cysts, reduce distribution system pressures to reasonable values, provide distribution system storage, and provide service meters as an equitable way of apportioning system construction and operation costs.

These objectives were achieved by adding a new water treatment plant and dividing the distribution system into two pressure zones, each regulated by concrete storage reservoirs with a pressure reducing valve station separating the two. Water meters were installed on all services, and undersized distribution mains in the newly created lower pressure zone were upgraded.

The improvements were implemented in two phases. In the first phase, the distribution system modifications were made to separate the two pressure zones. In the lower zone, a 0.75-mg storage tank was constructed and connected to an existing shallow 1-mgd well located in the lower distribution zone. This well had been developed in the 1960s to augment low pressure in the central business district during fire flow conditions.

The decision to implement a surface water treatment plant instead of developing wells as the sole source of supply was based on several considerations:

* the city had the first water right on a stream source which would have been relinquished without compensation if its use was discontinued
* the source feeds the service area by gravity
* the groundwater aquifer available for wells is shallow and difficult to protect due to the presence of existing development with on-site wastewater disposal systems
* the surface source water has a low turbidity which could be treated economically by direct filtration.

Plant design criteria were established by on-site testing. The treatment objectives established for Giardia cyst removal by rapid sand filtration were a finished water turbidity of 0.10 NTU or less at all times and two hours of contact time for chlorine disinfection.

An eight-month pilot plant testing program was conducted at the stream intake to evaluate variations in stream conditions and direct filtration performance. The average raw water conditions encountered were:

| | |
|---|---|
| Turbidity (NTU) | 0.2-2.5 |
| Tempertature (F) | 32-34 |
| Alkalinity (mg/l $C_aCO_3$) | 30 |
| pH | 7-7.3 |

The pilot unit was operated for a brief period in a complete treatment mode and then as a direct filtration unit. The jar tests were used as a qualitative measure of floc development by a specified amount and type of conditioner, coagulant, and flocculent aid added, their sequence, and the apparent strength of the floc created. Actual filter runs defined the effectiveness of the coagulation and flocculation trials.

The design recommendations resulting from the pilot studies were:

* Chemical addition during rapid mix in the following order: bentonite, soda ash, alum and anionic polymer.
* Rapid mix Gt of 33,000
* Flocculation HRT (hydraulic retention time) of 10 minutes
* Mixed media filters, constant rate, with surface wash
* Continuous turbidity monitoring for process control and to initiate and stop filter to waste.
* No reclamation of backwash water due to concern about Giardia cyst contamination.

The new plant is fully automated and is controlled by a programmable controller. Plant start and stop functions are initiated by low and high level signals respectively from the upper service zone storage reservoir.

Start-up was accomplished in March 1984, and the facility has performed well without mechanical problems. Water production in terms of a seven-day moving average is depicted in **Figure 1.** It shows the decrease in daily production rate over time due to changing use habits driven by metered service. It also shows the decrease in the difference between influent water pumped to the treatment plant and flow delivered to the system. This difference represents both backwash water and filter-to-waste upon filter start-up. The reduction in this difference over time is due to a general reduction in water throughput, and process optimization through operator familiarity with the treatment system, and changes in the source on a daily and seasonal basis.

The plant has met the 0.10 NTU criteria for finished water turbidity over 98 percent of the time over an 809-day data-gathering period. With the exception of 7 days in the spring of 1985 during a period of high influent turbidity, a 7-day period when the chief operator attended a water school, and 2 days in the spring of 1986, the filter turbidity has been equal to or less

than 0.10 NTU. Turbidity removal through the treatment plant is presented in **Figure 2**. Filter runs average about 40 hours.

The State of Montana Department of Health and Environmental Sciences has conducted a sampling and analysis program on two separate occasions to measure the presence of Giardia cysts in the raw and finished water. The results found cysts and large amounts of Giardia-size material in the raw water, while the finished water contained little suspended matter and no cysts. The contact flocculator/clarifier and filter backwash was sampled, but contained too much flocculated matter to visually identify cysts.

Annual costs for chemicals, power, labor, and maintenance include:

| O&M | $/Year | $/1000 gal. |
|---|---|---|
| Power | $10,623 | $0.044 |
| Chemicals | 7,168 | 0.029 |
| Labor | 16,425 | 0.068 |
| | $34,216 | $0.141 |

The cost of constructing the water treatment plant, upper zone storage, facilities, and low service pump station was $1.2 million in May 1983. When updated to the first quarter 1987 and amortized at 10 percent interest over 20 years, the annual capital cost is $153,200.

This treatment plant designed for Red Lodge has greatly reduced the likelihood of another Giardia outbreak. The new system has promoted reduced water consumption while improving water delivery. Residents now have a water supply and treatment system that will serve them for some time to come.

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**About the Authors:**
Michael R. Alberi, Vice President, and Steven J. Quail, Project Engineer, are both with Woodard & Curran, Inc., Consultants, Portland, Maine. Robert A. Kruse is Water Superintendent, Red Lodge, Montana.

**Figure 1**

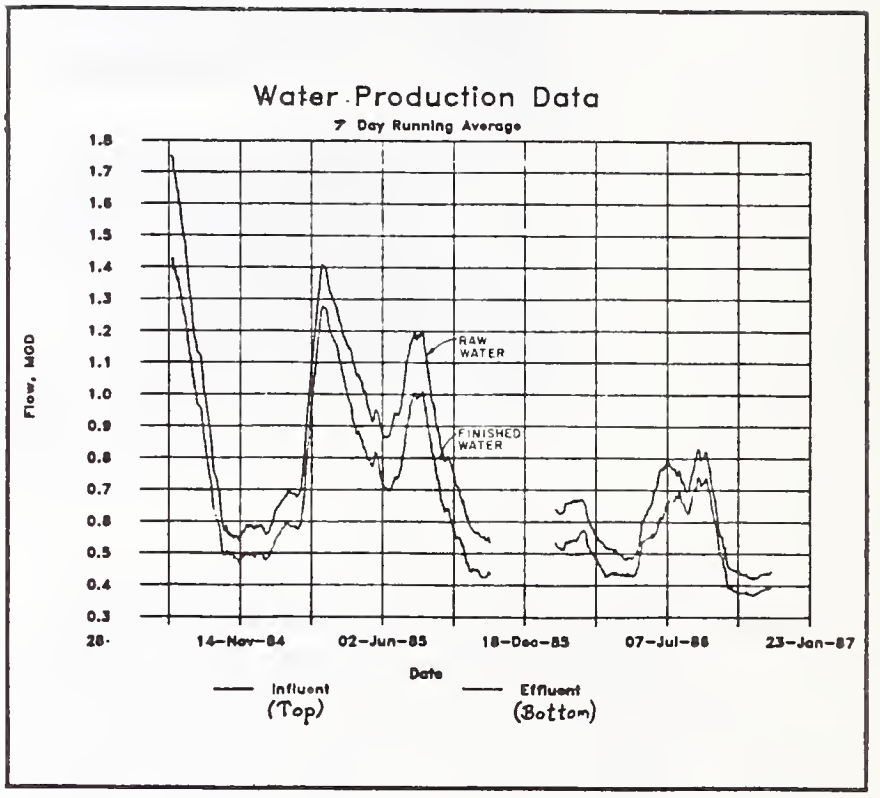
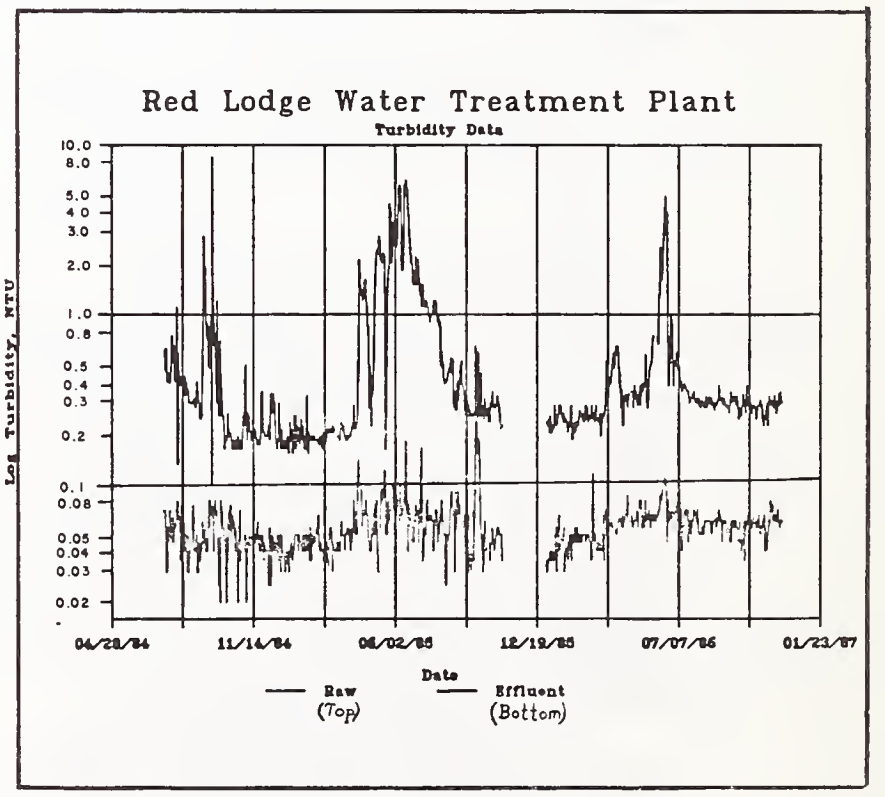



**Figure 2**



# EXAMINATION NOTICE

**ON SATURDAY----------MARCH 12,1988----------9:30 A.M.**

**Examinations for certification as a Water Distribution System Operator, Water Plant Operator and Wastewater Plant Operator will be given at these seven locations:**

**BILLINGS-----** Lewis Room, Student Union Building, Eastern Montana College

**GLENDIVE-----** Room 138, Dawson Community College, 300 College Drive

**GREAT FALLS--** Room S119, Science Amphitheater, College of Great Falls

**HAVRE--------** Room 103-4, Hagener Science Center, Northern Montana College

**HELENA-------** Room C209, Cogswell Building, (Broadway entrance)

**KALISPELL----** Room 37, Montana Hall, Flathead Valley Community College, 15 First St.E.

**MISSOULA-----** Room 102, Liberal Arts Building, University of Montana

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**By February 26, as required by ARM 16.18.204, everyone taking examinations must have:**
--completed an application for certification as a water/wastewater operator.
--paid application (or renewal) fees for fiscal year 88 which ends 6/30/88.
--submitted examination registration slips and fees of $5 per examination.

**APPLICATION FEES ARE: Class 1-$27; Class 2-$22: Class 3-$17; Class 4-$12; Class 5-$10**
To request application materials, order study materials, or ask for additional information call the certification office at 444-2691 or write: DHES-WATER QUALITY BUREAU;Water/Wastewater Operator Certification; Room A206, Cogswell Building, Helena, Mt. 59620. **RETAIN THE UPPER PORTION OF THIS NOTICE, PLEASE.**

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**EXAMINATION REGISTRATION SLIP**
(Detach and return with $5 per examination by 2/26/87)

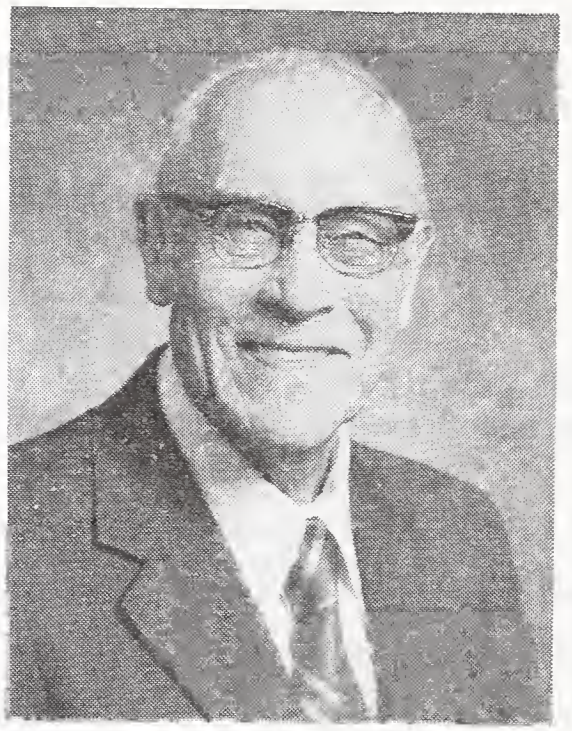
I will take the examination(s) I have checked below at: ___Billings; ___Glendive; ___Great Falls; ___Havre; ___Helena; ___Kalispell; ___Missoula

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| A--Water Distribution | _____ | _____ | _____ | _____ | _____ |
| B--Water Plant | _____ | _____ | _____ | _____ | _____ |
| C--Wastewater Plant | _____ | _____ | _____ | _____ | |

*Combination examination 2A3B, 3A4B, 4A4B, and 5A5B require $5 exam fee only.

NAME_____ADDRESS_____SYSTEM_____

The following article is a reprint of a biannual report from a collection of papers found deep in the Water Quality Bureau archives. The papers are the work of Herbert B. Foote who was employed with the state as a sanitary engineer from 1917 through 1952. Mr. Foote was born September 27, 1886 and passed away on March 8, 1976. Mr. Foote received numerous awards from professional organizations and his peers in the field of engineering. His work and period of service in the public health arena exemplifies H. B. Foote as a true pioneer in the development of water and wastewater systems in Montana. Additional articles will be reprinted in future issues of the Big Sky Clearwater.



Helena, Montana
March 29, 1934

State Board of Health
Dr. W. F. Cogswell, Secretary
Helena, Montana

Gentlemen:

This is a report of the work of your water and sewage division for the six months ending March 24th. The work of the division has proceeded as usual, the routine of water analysis and inspection making up the bulk of the work. There were several events of special interest, however, which are herewith recounted briefly.

On November 24th, Dr. Cogswell and I went to Clyde Park to inspect the city water supply. We found that this water supply was being polluted by the watering of cattle and horses by Mrs. Fisher, owner of the land at the place where the city obtains water from springs. Following this inspection, Dr. Cogswell issued an order to Mrs. Fisher to discontinue the pollution of the city water supply. There has been a contention of long standing between the Fishers and the various city officials of Clyde Park over this question, and it appeared to us that the conditions would not be remedied because of the antagonism existing between them, unless some special action were taken. Following the issuance of the order, Mrs. Fisher apparently attempted to comply, but would not allow the city to obtain all the water which the city contended legally belonged to the city unless the city in turn would provide her with a watering trough so that her stock would have an ample supply. The city council would not agree to this. It was necessary, therefore, that we again go to Clyde Park, which we did in February of this year. At this time, Dr. Cogswell secured agreements between the city council and Mrs. Fisher as to their respective obligations and what they would do to preserve the purity of the water. Dr. Stuart, county health officer at Livingston, has reported that progress has been made toward a correction of the situation.

On December first, at the invitation of Dr. O'Leary, Mayor of Big Timber, I attended a public meeting and spoke relative to the desirability and necessity of correcting conditions on the city water supply. The meeting was held just previous to an election to determine if the citizens of Big Timber would favor a bond issue to rebuild the water supply system. Through later advices, we have learned that the bond issue carried by a substantial majority. Money is to be obtained from the Public Works Administration when such money is available.

From December 2nd to December 9th, on subpoenas from the local district court, I attended and testified in a case arising from the typhoid epidemic in Helena, 1929. The jury in this case, Safransky vs. City of Helena, brought in a verdict for the plaintiff, allowing $1,500 damages, although $20,000.00 had been asked for.

The work of certification of water supplies used on passenger trains during 1933, was completed. 27 favorable certificates were recommended and two provisional. This is an improvement over the year before. In this connection, Miles City has been given a provisional certificate for two years. Such a certificate is based on the fact that while the water delivered by the city water filtration plant is of satisfactory sanitary quality, there are a number of cross connections in the city which constitute sanitary defects and do not allow of favorable certification. These cross connections are between the city water supply and soft water wells which were originally flowing, this being an artesian area. Because of changing conditions and heavy draft on this artesian water supply, the situation has changed from that in which water flowed and was of unquestioned purity to that in which the water no longer flows and there is a suspicion that this water may at times at least be subject to contamination. Of something over 100 such cross connections, through the efforts of the State Board of Health cooperating with the city officials, 47 have been provided with the approved double check valve installations. When I was in Miles City on February 9th, I saw one such installation and learned that the city officials and local plumbers are keeping up the campaign to get these all taken care of. The industrial users of the artesian water have taken care of their supplies. The State School for Boys at Miles City uses this artesian water from wells which have been drilled on the school property. We analyse water from these wells at regular intervals and there is no suspicion of the sanitary quality of this water because of the location of the wells and the satisfactory sanitary quality which has been determined.

On January 24th, at the invitation of Dean W. M. Cobleigh of the State College, a lecture was given to a class of about 90 engineers. These were sophomores and juniors in the Engineering School. Dr. Cogswell and I attended a luncheon of the Engineering Faculty that day.

On November 17th, Mr. Thane of the Montana Power Company at Missoula telephoned to inform the State Board of Health that someone had thrown Paris Green into the city water reservoir during the previous night. He requested assistance in determining the condition of the city water on account of this fact. Mr. Morgan was sent immediately to Missoula with instructions to work with the water company officials and Dr. Pease in efforts to protect the public health. He took equipment for arsenic determinations and stayed in Missoula a few days, making investigations and analyses. While Mr. Morgan recovered arsenic from the samples of water which he tested, the amounts were so small as to be of no significance as far as the health was concerned. This experience, fortunate in its particular outcome, emphasizes to us all the necessity of close watch on any features of public water supply. So far as we are informed, the perpetrator has not yet been apprehended. No one seems to know the motive which was behind the deed.

During the past several months we have been asked to make investigations and statements relative to the desirability and necessity of building water supply systems and sewerage facilities in several communities in the state. In this connection, 16 or more mineral analyses have been made. 15 field inspections have been conducted, and letters or statements in other form have been made on 21 situations.

The Ninth annual meeting of the Montana Section, A. W. W. A., will be held in Billings on April 20th and 21st this year. We are anticipating a large and enthusiastic attendance. Our program comprises addresses and papers on such pertinent subjects as the work of the Public Works Administration, the Fort Peck Dam project, and the work of the Civil Works Administration as it pertains to municipal improvements. Interspersed, there will be round table discussions of subjects pertinent to the water supply business and a trip to the local filtration plant.

On April 18th and 19th, Dean W. M. Cobleigh of the Engineering School at the State College, Bozeman, and I will conduct the third Water Works Operators School. You have been informed of these schools in previous reports. Last year at Havre, there were 50 registered for this School. The year before at Bozeman, there were 42. We expect a further increase this year since we have learned of the interest which has been aroused among water works and other municipal officials all over the state. As this school is in part sponsored by the State Board of Health and is becoming one of the annual activities of the Water and Sewage Division, its present status is herewith called to your attention. I feel that this activity is very much worthwhile and I can see results which apparently are coming from it. I have been informed that there is a committee of the American Public Health Association on professional education which is giving some attention to such schools as this, having an idea of elevating them to certain standards so that graduates therefrom will have acquired qualifications entitling them to certain graded positions in a tabulated list of professional public health works, which is contemplated by the A. P. H. A.

The tabulation given below shows the work that the Water and Sewage laboratory has done for the period beginning September 15th, 1933, and ending March 24th, 1934 (since my last report).

Laboratory work:

| | | Previous 6 months |
|---|---|---|
| Bacteriological samples analysed | 2,263 | 2,453 |
| Chemical " " | 103 | 97 |
| | 2,366 | 2,550 |

Field work:

| | | Previous 6 months |
|---|---|---|
| Public water supplies investigated | 30 | 56 |
| Sewage disposal systems investigated | 8 | 14 |
| Miscellaneous | 17 | 22 |
| | 55 | 92 |

Respectfully submitted

H. B. Foote

H. B. Foote, Director,
Division of Water & Sewage

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TO: WASTEWATER OPERATORS AND MWPCA MEMBERS
FROM: KRISTI KLINE - MEMBERSHIP CHAIRMAN, MWPCA

The Water Pollution Control Federation has available the new Water Quality Curriculum Series for seventh through ninth grade students. The material was designed to help students and teachers better understand wastewater treatment in a way that is both informative and interesting.

The material includes a video that makes the students realize that wastewater treatment is much more than just another chapter in their science book. Along with the video, there is a Student Resource Guide that covers such topics as treatment plant processes and how they work, the people involved in wastewater treatment, and how the students can play a role in protecting our water supplies. Also included is a Teacher's Resource Guide which highlights important topics covered in the Student's Guide and outlines some activities to get the students thinking and talking.

The Joint Education Committee of MWPCA and MAWWA purchased this training package and it is in the Lending Library at Northern Montana College in Havre. If anyone would like to borrow this package to use at their school, please contact me at 265-9031 or P.O. Box 231 - Havre, Mt 59501. If you would like me to contact your school, please give me the interested teachers' name(s) and I will talk to them about this material.

It is WPCF's intent that wastewater treatment plant personnel and member associations take a leadership role in endorsing this material. This package could be purchased by any school or wastewater plant so that it could be used on a regular basis. It is an excellent source of material for preparing students before they come to treatment plants for tours. It gives more information than what is contained in their books and they will benefit by actually seeing a real wastewater treatment plant in action. This publication can be purchased from the WPCF Public Education Department, 601 Wythe Street, Alexandria, Virginia 22314-1994.

The following information was taken from WPCF Application Literature. It was also submited by Kristi Kline.

AS PROFESSIONAL WASTEWATER OPERATORS,
YOU CAN BENEFIT FROM MEMBERSHIP IN
THE WATER POLLUTION CONTROL FEDERATION'S
PROFESSIONAL WASTEWATER OPERATIONS DIVISION (PWOD)

Why a division especially for operators?

WPCF recognizes that wastewater treatment professionals provide one of the most essential services in the environmental field. Operators have specialized interests and needs. WPCF created the PWOD to meet those needs.

How can joining a PWOD help me in my job?

As a member, you will receive Operations Forum, a new magazine dedicated to the needs of treatment plant operations, laboratory controls, collection systems, and maintenance personnel. Operations Forum is designed to help you, the wastewater operations specialist, improve your skills and maintain top system performance. Information on job advancement, improving your professional status, and enhancing your image in the community -- these are all goals of the Forum.

What exactly will I read about in Operations Forum?

Future topics to be covered in Operations Forum include:

Laboratory Management -- Sample collection and preservation, levels of precision, and quality control at laboratories in wastewater treatment plants.

Process Control Instruments -- Selecting and using samplers, monitors, indicators, and recorders; the latest in new technology and equipment.

Operating a Package Plant -- Is it really as simple as it sounds?

Sludge Disposal -- Sludge disposal methods, equipment, and techniques for efficient management of sludge.

Annual Safety Survey -- Results of WPCF's survey of accidents and injuries at U.S. and Canadian treatment plants.

Plus, in every issue, there is a Certification Quiz to keep you sharp, a Bulletin Board for the latest news, and information on operations in North America.

Are there other benefits?

Sure! Many benefits are available to you as a PWOD member in WPCF. You'll be eligible for substantial discounts on practical wastewater publications and for group insurance rates (including disability). WPCF has public education materials that can help you be an effective messenger of clean water information in your community. You know and WPCF knows how important operations professionals are to your community -- now it's time the public learns about the essential services provided by wastewater operators.

Anything else?

WPCF's Annual Conference and Exposition is the largest of its kind. The week-long event attracts more than 10,000 participants who gather to attend technical sessions and review up to 300 manufacturers and firms exhibiting their equipment and processes at the Exposition. A discount for conference registration is available to members.

As a PWOD member, you may choose to "add on" a subscription to the widely acclaimed Journal Water Pollution Control Federation as well as Highlights, WPCF's monthly newsletter, at a reduced subscription rate.

How much will it cost me to join?

Membership in the Professional Wastewater Operations Division is $15 annually, plus local dues of your WPCF member association or recognized operators association.

I've heard about WPCF; what exactly is it?

Since 1928 the Water Pollution Control Federation has been the leader in developing and disseminating information concerning the nature, collection and treatment of domestic and industrial wastewater. We're a non-profit, educational organization of distinguished wastewater problem solvers. Throughout the last 56 years, it has been WPCF members, some 30,000 strong today, that have been the driving force behind the nation's clean water program.

Where can I sign up to become a PWOD member of WPCF?

Please contact Kristi Kline for the necessary application. Give her a call at 265-9031 or write P.O. Box 231 - Havre, Montana 59501.

# NPDES PERMITS:

## NEW BIOMONITORING REQUIREMENTS ON THE HORIZON

By: Fred Shewman, Water Quality Bureau

The 1987 Federal Water Pollution Control Act states that discharges of toxic pollutants in toxic amounts be prohibited. Up to the present time, this policy has not meant much to Montana. States having more industry than Montana have dealt more with the reality of problems caused by toxic discharges in the past. Montana has been lucky, by and large, needing to require only the federally-mandated minimum treatment of its dischargers. Most Montana wastewater treatment facilities have not been required to test for a long list of exotic toxic chemicals, much less have limits for them imposed in their discharge permits.

The EPA has begun to change methodology somewhat in dealing with toxics. Rather than test for a long list of specific toxic chemicals to see if certain levels are exceeded in a discharge, EPA is beginning to realize that it is quicker and cheaper to see how living organisms respond to living in a particular effluent. The organisms are placed in samples of the effluent first, then, if the organisms are adversely affected, more work must be done to determine the cause of the problem in the particular discharge.

Research needed to implement a successful biological testing program began in the mid-1970s. As a result, quick, reliable, and inexpensive biological tests to measure the toxicity of complex effluents to a number of vertebrate (Fathead minnow), invertebrate (Ceriodaphnia dubia), and plant species (Selenastrum capricornutum) have been developed, validated, and published. These toxicity tests allow regulatory authorities to measure both acute (immediate) and chronic (long-term) effects of toxic effluents in a cost-effective manner.

As of October, 1987, EPA now requires biomonitoring to be considered in all expiring major permits. Montana submitted several drafts of a proposed rationale for biomonitoring requirements to EPA for approval. EPA has tentatively approved a biomonitoring rationale for Montana. Standard test organisms for Montana are expected to be Ceriodaphnia and Fathead minnows. Initially, quarterly tests will be required. For discharges that are diluted more than 20:1 by the receiving stream, acute testing (a short-term, simpler test) will be required. For discharges that do not have as much dilution, chronic testing (longer, more complicated) will be required. If toxicity is not shown, frequency of bioassays may be reduced to twice per year, and screening tests may be simplified to acute only. If toxicity is shown, the Department will work with the discharger to determine a course of action to resolve the problem. Eventually, then, routine screening bioassays should demonstrate that the state's discharges are not causing toxicity problems.

EPA is also requiring the incorporation of more specific toxics prohibition language in the current revision of the state's Water Quality Standards. Whatever the end result of toxics language in the Standards may be, subsequent NPDES permits will be designed to reflect that language and assure compliance with the Standards. Credit for dilution by the receiving stream does not appear to be completely acceptable to EPA at this point, although it may be taken into consideration in determining whether acute or chronic effluent testing is required.

There are still some problems to be worked out, such as how do we treat toxicity caused by the "conventional" pollutants such as chlorine, ammonia, and low dissolved oxygen in discharges. One option might be to exclude, by definition, toxicity caused by these conventionals. Another possible solution might be to utilize diffusers for discharges, thereby eliminating the "mixing zone," which might contain acute toxicity from a non-mixed discharge. It does appear, however, that biomonitoring will definitely be a future requirement for some of our NPDES dischargers.

What is involved in running the tests? There is generally not a lot of sophisticated equipment required, but expertise is useful in running the tests and interpreting the results. Copies of biomonitoring protocols are available from the WQB; additionally, private testing labs are presently contracting to do the tests in other states. A sampling from Colorado shows contract lab costs may run from $800 to $1,100 for two-species acute tests and from $1,400 to $2,200 for two-species chronic tests. There are presently no known in-state labs running these tests. Some of the larger Colorado dischargers are running their own tests.

EPA is proposing to hold one to two Biomonitoring Workshops in Montana during April or early May. These workshops will be for two days each and will consist of actually performing biomonitoring tests in the laboratory. The location of the workshops is yet to be determined. If you are interested in attending this workshop and learning how to do biomonitoring tests, please contact Fred Shewman at the Water Quality Bureau in Helena at 444-2406.

# WATER MAIN EVALUATION FOR REHABILITATION/REPLACEMENT

The Water Quality Bureau recently received a project summary document from the EPA which addressed the above mentioned subject. Whenever the EPA completes a research project, they send out a summary pamphlet about the project which outlines the conclusions and recommendations from the study.

Due to the fact that many communities in Montana are supplied water through distribution systems that are old and deteriorating, the information contained in this report may be of interest to the people in charge of operating and maintaining such systems. This information would also be of interest to communities with newer systems if they are concerned with developing an ongoing maintenance program.

Quoting from the project summary, "This report describes a series of studies that identified factors contributing to water main failures and developed decision strategies on main rehabilitation, replacement, and preventative maintenance. The objective of this report is to provide the water utility industry with practical methods to assess long-term changes in the condition of distribution systems and to assist in rehabilitation/replacement planning decisions."

If you are interested in obtaining a copy of the complete report, you need to write to the National Technical Information Service -5285 Port Royal Road - Springfield, Virginia 22161. The telephone number is (703) 487-4650. The report is entitled "Water Main Evaluation for Rehabilitation/Replacement" and the order number is PB 87-175378/AS. The cost of the publication is $18.95.

# THE 1986 AMENDMENTS TO THE SAFE DRINKING WATER ACT

By: Dan Fraser, Water Quality Bureau

**SUMMARY**

In May of 1986 Congress overwhelmingly passed a comprehensive set of amendments to the Safe Drinking Water Act (SDWA). In June of the same year President Reagan signed the amendments into law and a new array of challenges materialized for public water supplies and regulators responsible for the enforcement of this law.

Prior to the 1986 amendments about 23 contaminants had been regulated by the SDWA and by Montana's primacy agency, the Department of Health and Environmental Sciences. The amendments have mandated the U.S. Environmental Protection Agency to promulgate regulations for a list of 83 contaminants (including those already regulated) by June of 1989. Nine were to be finalized by June of 1987, another 40 by June of 1988 and a final 34 by June of 1989.

Additionally, the amendments require EPA to establish a list of other contaminants "known or anticipated to occur in public water systems and which may require regulation." This list is to be completed by January 1, 1988. Then, no later than January 1, 1991, EPA is to finalize regulations for at least 25 of the contaminants on the list. The list is to be updated periodically and regulations are to be promulgated for another 25 every three years after 1991.

The first nine that were due to be regulated last year included fluoride and eight volatile organic compounds (VOCs). These regulations have been finalized and the MCL (maximum contaminant level) for fluoride has been raised from 2.4 mg/l to 4.0 mg/l while new MCLs have been established for Benzene, Carbon Tetrachloride, 1,2 - Dichloroethane, Trichloroethylene, Para-Dichlorobenzene, 1,1 - Dichloroethylene, 1,1,1 - Trichloroethane and Vinyl Chloride. Monitoring requirements were established by the new rules and the initial monitoring is to be phased in according to the size of the population served by the system. Systems that serve greater than 10,000 people must begin monitoring by January 1, 1988. Systems that serve from 3,300 to 10,000 must begin monitoring by January 1, 1989 and those that serve less than 3,300 must begin monitoring no later than January 1, 1991.

Another important part of the regulations promulgated during the summer of 1987 is a new definition, or category, of non-community public water system. This new category is "non-transient non-community water systems" (NTNCWSs). Systems that fit this definition are now to be considered community water systems for regulatory purposes. NTNCWSs are those that regularly serve the same 25 or more persons at least 6 months out of the year. They would include such non-community systems as schools and factories that have their own water systems. These systems will now be responsible for the same monitoring requirements as are the community systems and they will have to sample for organics, inorganics and radiological contaminants.

*Furthermore, EPA is required by December of 1987, to develop criteria by which states can determine what systems that utilize surface waters will have to provide filtration. By June of 1989 EPA is also to have finalized criteria by which the states can determine what public water systems will have to provide continuous disinfection for their finished waters. These criteria are intended to ensure that, when exceptions to the filtration (surface water) and disinfection (ground water) requirements are given, the health of the water users is adequately protected.*

## *IMPACT ON MONTANA'S PUBLIC SYSTEMS*

*Most of Montana's public systems are classified as "small public water systems" (those that serve less than 3,300 persons). In fact, the department's computer inventory listing of public water systems (PWSs) shows a list of 2329 PWSs and only 29 (1.25%) of them actually serve greater than 3,300 people. The small systems are the ones generally least able to afford increased monitoring costs and obviously, the monitoring costs are going to be going up with the new regulations. The extent of the increased costs is yet to be determined. If all of the new rules are finalized, including the Total Coliform Rule, as proposed in the Nov. 9, 1987 Federal Register, the costs will be high. This rule will require all systems to submit a minimum of 5 coliform samples per month. Small systems now only submit 4 to 12 samples/year. At an estimated $15.00/sample, that would increase monitoring cost, for coliforms alone from $60.00/year (quarterly sampling) or $180.00/year (monthly sampling) up to $900.00 per year. That is an increase that may be difficult for some systems to afford.*

*We have about 30 systems in the state that utilize surface waters without filtration. The rules proposed in November include stringent watershed management and raw water monitoring requirements that will make it necessary for most systems to install filter plants or go to ground water.*

*EPA has assured the department that their intentions are to give as much flexibility to the states as they possibly can to determine what contaminants each system will have to monitor for and the frequency of monitoring that will be required. The contaminants to be monitored and the monitoring frequency are to be determined by a number of factors including system vulnerability, population served, protection of the aquifer and other system characteristics. They seem to envision determinations being made for each PWS when a sanitary survey is conducted by the department.*

*The department held a series of 12 public informational meetings around the state to discuss amendments, proposed rules, up-coming rules and their impact on Montana's small systems. These meetings were all held in mid-December and were well attended. The department encourages all interested parties to keep in touch with the rule making process and to provide the Environmental Protection Agency with comments and concerns. We feel that this is valuable information that is badly needed by the EPA in order for them to write good and comprehensive regulations which will adequately protect the health of water consumers while not breaking the bank. Feedback we have recently received from EPA's Criteria and Standards Division in Washington, D.C., indicates they have already heard from many of Montana's PWSs, they appreciate the comments and are in the process of giving consideration to some of the suggestions that have been made. Public officials do respond to pubic pressure, so be sure and let them know where you stand on these very important issues. If you have any questions, please contact the Water Quality Bureau at 444-2406.*

# CEC UPDATE

By: Rosemary Fossum

By June 30, 1988, all fully certified Class 1-4 operators who were certified before October 1, 1986, must have reported continuing education credits sufficient to meet the following requirements: Class 1 fully certified operators in either water distribution or water treatment or both - 1 CEC; Class 1 fully certified operators in wastewater treatment - 1 CEC; Class 2 or 3 or 4 fully certified operators in either water distribution or water treatment or both - 1/2 CEC; Class 2 or 3 or 4 fully certified operators in wastewater treatment - 1/2 CEC. The following rules are pertinent to these requirements:

- The certificate(s) of operators who do not fulfill the CEC requirements will expire on June 30 but may be reissued upon passing the appropriate examination(s).

- An extension of time of up to one year within which to fulfill the CEC requirements may be granted in individual cases which involve hardship or extenuating circumstances beyond the control of the operator such as a health-related confinement. All requests for such an extension must be well documented and must be made prior to March 31, 1988.

- Subject to documentation and department approval, an operator shall be deemed to have complied with the continuing education requirements during periods when he/she:

    - serves honorably on active duty in the military services, OR

    - is a resident of another state which has continuing education credit requirements and meets those requirements, OR

    - is a government employee working as an operator and assigned duty outside the U. S.

Reprints of the continuing education regulation itself or the special CEC information article entitled ANSWERING YOUR QUESTIONS ABOUT CEC'S are available upon request from the certification office, Room A206 Cogswell Building, Helena, Mt. 59620, Phone: 444-2691.

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# NEVER TRUST AN UNDERGROUND STORAGE TANK (UST)

## NO SMOKING IN LIVINGSTON, MT

By: K. Bill Clark - Water Quality Bureau

On September 3, 1987, the Water Quality Bureau received a call from the Livingston Fire Department. They had responded to a report of gasoline vapors in several downtown businesses. The fire department was concerned with the threat of explosion; we shared this concern along with those of threatened public health and the environment.

The fire chief mentioned that a nearby service station had a fuel release in mid-August. The following day I contacted the owner of the service station. He said that he discovered a 306 gallon gasoline loss between June 30 and August 22. On the 23rd, he traced the problem to a leaking steel-reinforced rubber connecting pipe attached to the underground storage tank and product delivery line. He replaced the connector with a steel pipe.

In a letter sent on September 9, 1987, the owner was formally notified that he violated the Montana Water Quality Act and that he must fulfill our corrective action requirements. With fuel releases of this type, the State of Montana requires that a corrective action program be developed and implemented. The program must evaluate the impacts of the fugitive fuel on existing and future beneficial uses of ground and surface waters. The program must also address fire, safety and health hazards from vapor accumulation in confined spaces.

In general, corrective action involves describing the subsurface nature and extent of four physical phases of the petroleum product: 1) the free phase (fuel floating on the water table), 2) adsorbed phase (fuel attached to soil particles), 3) vapor phase (fuel evaporating from the free or adsorbed phases) and, 4) dissolved phase (petroleum constituents that become soluble in water). With this release we suspected health and environmental risks from each phase.

The September 9th letter required a commitment to conduct the corrective action program within seven days. During this time period the station owner reevaluated his inventory records and found that over 5,000 gallons of gasoline was released. This announcement changed the urgency of the situation.

THE INVESTIGATION BEGINS

We immediately began to conduct site inspections and air monitoring while reviewing information on the hydrogeological setting of Livingston. The site is located in a downtown area. The area is paved, developed and has numerous utility trenches in the streets. The buildings affected with vapors include several retail businesses, a hotel with permanent residents, a railroad depot, a restaurant and several other buildings. All had basements. Air monitoring in the basements with a Miran infrared analyzer indicated gasoline vapors from 6 to over 500 parts per million (ppm). (The 8-hour time weighted average for occupationally exposed workers is 300 ppm).

The city of Livingston derives its entire water supply from a thin near-surface aquifer. The aquifer is unconfined, composed of coarse sand and gravel and is about 50 feet thick. The water table is less than 20 feet from the ground surface and therefore

vulnerable to contamination. What made matters worse was the location of a municipal well less than 1500 feet downgradient of the gasoline station.

## SECURING FUNDING

As the deadline for a response from the owner approached, we learned of the concerns of city officials. The mayor of Livingston sent a letter to the governor requesting assistance due to the emergency nature of the gasoline vapors and the threatened municipal well. The governor authorized use of state Environmental Contingency Funds to fund the investigation. In addition, DHES requested money from the Federal Underground Storage Tank Trust Fund (UST Trust) and received $127,000 -- the first site specific expenditure in the country. It should be noted that with either source of funds, the owner of the station is ultimately responsible for all costs incurred.

## DETERMINING THE EXTENT OF THE PROBLEM

The DHES retained a hydrogeological consulting firm to conduct the investigation. Department personnel and the consultants decided upon a three phased approach which included: emergency response activities, site characterization and remedial actions.

The emergency response activities centered on mitigating health and safety hazards from gasoline vapors in the affected buildings. Daily air monitoring was conducted and the DHES established "action levels" which are designed to initiate action when vapor levels approach explosion or health risk threshholds. Because action levels were exceeded, positive air ventilation systems were designed and installed in four basements. Positive air pressure prevents the entry of vapors into the basements. The systems have been successful in keeping vapor concentrations below the action levels thereby minimizing health and safety hazards.

In conjuction with the installation of ventilation systems, the site characterization phase was implemented. The purpose of site characterization was to provide information on the extent of groundwater and unsaturated zone contamination and the direction and magnitude of contaminant migration. This phase also included an inventory of other underground storage tanks and domestic wells within the area. In addition, five monitoring wells were completed and four additional boreholes were drilled and plugged. The wells provided information on contaminant geometry, lithology and ground water occurrence, movement and quality.

At the time of drilling (late September and early October), only three of the nine wells showed signs of contamination. The contamination was gasoline-soaked soils one to two feet above the water table. No free product was encountered. The three wells were essentially on a parallel line and seemed to represent the direction of ground water flow when the fuel release occurred. The soil material was uniform in each well. The top 4 to 5 feet was silty clay. Below this layer, intermixed layers of gravel, sandy gravel and sand extended to below the water table. After surveying water table elevations in the wells, we prepared water table maps. The maps, based on water levels from October to January, indicate that the water table fluctuates several feet seasonally and that ground water flow has a seasonal orientation. It appears that in the winter low ground water period, the flow is toward the downtown area and the city well.

The five monitoring wells were sampled for the water soluble constituents of gasoline--benzene, toluene and xylenes (BTX). On the first sampling run, the well nearest the station had 8,600 parts per billion (ppb) total BTX. The other wells were clean. In the second sampling run, the same well was contaminated but the levels decreased to 98 ppb. (The

*maximum contaminant level for benzene in drinking water is 5 ppb).*

*From the results of the drilling program and information from other groundwater studies in Livingston, we were able to make several conclusions: 1) ground water velocity averages about 10 to 20 feet per day, 2) the ground water flow direction during the period of the fuel release (June 30 to August 22) was not directed toward the nearest city well, 3) the gasoline appeared restricted to a one and one-half block long, 100-200 foot wide zone in soils above the water table, and, 4) dissolved gasoline contituents appeared to be decreasing with falling water levels. However, vapor levels in localized hot spots in several basements continued to approach our action levels. Also, the eventual rise of the water table would inundate contaminated soils and further threaten the city water supply. Therefore, our remedial action program was designed to attend to these concerns while remaining flexible.*

## *CORRECTIVE ACTION*

*The preferred remedial action was a soil venting program in one of the affected basements. Soil venting is essentially a method which vacuums soil air from the subsurface. The soil air also has gasoline in it. Thus, by using soil venting we can actually remove and eliminate the source of the vapors. The other benefit of soil venting is that it is probably more cost effective in the long run than suppling positive air pressure, which is heated in the winter, to the basements.*

*Our soil venting system involved hand digging three six foot deep holes beneath the basement slab. The soil gas wells are screened and manifolded to an explosion-proof blower. The vapors are vented to the outside atmosphere. At each well, valves allow us to control air flow and vacuum in the soil. We also have a sampling port to allow us to measure gasoline vapor concentrations.*

*The initial results of the soil venting system are encouraging. After 24 hours we were removing over 5,000 ppm gasoline vapors with an air flow of over 50 cubic feet per minute. We anticipate that the vapor concentrations will slowly level off and remain fairly constant. In addition, we hope to turn off the positive air ventilation and allow soil venting to control vapor concentrations.*

## *SUMMARY*

*The project is currently in an active remedial action phase. We will continue to monitor vapor concentrations and ground water. A recent discovery of free product in one monitoring well mandates reexamination of our hypothesis and future direction. We remain hopeful that soil gas venting will continue to be an effective means of both treating the symptoms of the release and eliminating the source of the vapors.*

*This example of what can occur with the storage of petroleum products underground in close proximity to a ground water supply, is both tragic and classic. I believe that the magnitude of the problem resulted from the lack of daily fuel accounting. Petroleum products must be tracked and accounted for from oil well to the gas tank in your pickup. If not, then we will experience even more environmental and health problems. Each of these problems are expensive to remedy--to date this project has cost over $70,000 and is not yet completed. This particular problem exemplifies the battle against ground water pollution we are facing. It is my opinion that the corner gasoline station will pass away and our ground water will continue to receive fugitive fuel.*

*Footnote: Many thanks to Dave Frederick, Livingston Fire Chief, Mike Jacobson, city superintendent, and Clint Tinsley, water foreman, for their help and humor.*

This article appeared in the Helena newspaper on September 26, 1987 and it may be of interest to some of you that are trying to maintain an older distribution system. It serves to point out the liability involved in the operation and ownership of a water system. The decision of the jury definitely makes a town, water district or private owner think about the need for main replacement.

# First Bank Wins Suit Against City

By: Jill Sundby
IR Staff Writer

The City of Helena must pay $308,747 to First Bank Helena (formerly First National Bank and Trust Co.) for water damage incurred at the bank when a city water main broke in December of '83, a jury decided Thursday night.

Nine of the twelve jurors in the case voted in favor of the bank, while three supported the city. Only a two-thirds vote is needed to return a verdict in a civil case.

The trial began Monday and was held in District Judge Honzel's court.

It was a cold Christmas morning around 3 a.m. when the city water main beneath the street at Sixth and Fuller Avenues broke. By the time a city water department worker arrived at the scene, the water was spouting up through the street in a 12-to 18-inch high geyser, according to court records.

The water didn't get shut off until 11 a.m., according to the court report. The bank claimed the water entered the bank's basement level and soaked the soil beneath the basement, causing structural damage and damaging real and personal property.

The water main -- a six-inch diameter cast iron pipe -- was installed sometime before 1916, records show. The bank claimed the city was negligent for failing to replace the main and for failing to respond promptly when the main broke.

The city denied claims city employees were negligent in servicing, maintenance and inspection. The city argued that there is "no practical method of inspecting water mains" and the city can only record a main's history of leaks. That particular pipe, records show, had no leaks before it broke in December of '83.

The jury, however, found the evidence on the bank's side more convincing. "It was not an easy jury to sit on," said juror James Anderson. "It was a ticklish spot to be put in -- as a local taxpayer, they're suing you too."

The bank had asked for damages totaling $358,310.

# 1988 MONTANA OPERATOR TRAINING SCHEDULE

Following is a list of operator training events scheduled for 1988. Estimated fees and CEC's are given. As hard as we try not to, some changes in the schedule may occur. You will receive a specific agenda for each seminar 2-4 weeks prior to the seminar date from the sponsoring organization. If you have not received a notice 2 weeks prior to the scheduled date, please call the sponsor directly at the number listed below:

| | |
|---|---|
| Water Quality Bureau/Joint Education Committee | 444-2406 |
| Northern Montana College | 265-3757, ext. 3328 |
| Montana Rural Water | 454-1151 |

## TRAINING SCHEDULE - 1988

| DATE | TOPIC & EST. FEE | LOCATION | SPONSOR | EST. CEC'S |
|---|---|---|---|---|
| JAN 14 | BASIC WATER & WASTEWATER, $5.00 | BOZEMAN | WQB,NMC,JEC | .5 |
| JAN 20 | BASIC WATER & WASTEWATER, $5.00 | MILES CITY | WQB,NMC,JEC | .5 |
| JAN 21 | CLASS 5 CERT. REVIEW & EXAM PER CERT. FEE SCHEDULE | HELENA | WQB | .1 |
| JAN 26 | COST REDUCTION MANAGEMENT FOR WASTEWATER FACILITIES, $15.00 | BILLINGS | NMC | .5 |
| JAN 27 | PREVENTIVE MAINTENANCE FOR MUNICIPALITIES, $15.00 | BILLINGS | NMC | .5 |
| JAN 28 | CLASS 5 CERT. REVIEW & EXAM PER CERT. FEE SCHEDULE | MISSOULA | | WQB 1 |
| | ********** | | | |
| FEB 11 | BASIC WATER & WASTEWATER, $5.00 | HAVRE | WQB,NMC,JEC | .5 |
| FEB 19 | WATER TREATMENT PLANT DESIGN, $30.00 | HELENA | WQB,JEC | .7 |
| | ********** | | | |
| MAR 02 | CLASS 5 CERT. REVIEW & EXAM | KALISPELL | WQB | .1 |
| MAR 03 | BASIC WATER & WASTEWATER, $5.00 | BIGFORK | WQB,NMC,JEC | .5 |
| MAR 10 | MONTANA RURAL WATER SYSTEMS ANNUAL CONFERENCE | GREAT FALLS | MRWS | .5 |
| MAR 11 | CERTIFICATION MATH REVIEW | HAVRE,GLENDIVE HELENA,GREAT FALLS MISSOULA,KALISPELL | WQB | .3 |
| MAR 12 | CERTIFICATION EXAMINATIONS PER CERT. FEE SCHEDULE | HAVRE,GLENDIVE HELENA,GREAT FALLS MISSOULA,KALSIPELL | WQB | |
| MAR 16-18 | JOINT CONFERENCE MSAWWA & MWPCA | HELENA | AWWA/WPCF | 1.0 |
| | MEMBERS: FULL $75.00 NONMEMBERS: FULL $85.00 | | | |
| | MEMBERS: 1-DAY $50.00 NONMEMBERS: FULL $85.00 | | | |
| | SPOUSES: $20.00 | | | |
| | ********** | | | |

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|---|---|---|---|---|
| APR 6-7 | ADVANCED WATER TREATMENT, $20.00 | HELENA | WQB,JEC | 1.5 |
| APR 28 | BASIC OPERATIONS FOR SMALL WATER SYSTEMS | WOLF POINT | MRWS | .5 |

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|---|---|---|---|---|
| MAY 3-4 | TROUBLESHOOTING ACTIVATED SLUDGE SYSTEMS, $50.00 | GREAT FALLS | NMC | 1.5 |
| MAY 17 | CHLORINATION, $10.00 | HELENA | WQB,JEC | .5 |
| MAY 19 | CHLORINATION, $10.00 | SHELBY | WQB,JEC | .5 |
| MAY 25 | BASIC OPERATIONS FOR SMALL WATER SYSTEMS | W. GLACIER | MRWS | .5 |

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|---|---|---|---|---|
| JUN 07 | CHLORINATION | KALISPELL | MRWS | .5 |
| JUN 09 | CHLORINATION | FT. BELKNAP | MRWS | .5 |
| JUN 16 | SAFETY FOR WATER & WASTEWATER PERSONNEL, $10.00 | GREAT FALLS | WQB,JEC | .5 |
| JUN 23 | SAFETY FOR WATER & WASTEWATER PERSONNEL, $10.00 | BILLINGS | WQB,JEC | .5 |
| JUN 30 | SAFETY FOR WATER & WASTEWATER PERSONNEL, $10.00 | KALISPELL | WQB,JEC | .5 |

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|---|---|---|---|---|
| JUL 20 | WORKSHOP FOR WATER & WASTEWATER ADMINISTRATORS FEE NOT DETERMINED | GREAT FALLS | WQB,NMC,MRWS,JEC | .5 |

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|---|---|---|---|---|
| AUG 16,17,18 | ADVANCED WASTEWATER LABORATORY SCHOOL, $35.00 | GREAT FALLS | NMC | |
| AUG 25 | IRON & MANGANESE REMOVAL | BILLINGS | MRWS | .5 |

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|---|---|---|---|---|
| SEP 08 | BASIC OPERATIONS FOR SMALL WATER SYSTEMS | CROW AGENCY | MRWS | .5 |
| SEP 26-29 | ANNUAL SCHOOL FOR WATER & WASTEWATER OPERATORS, $50.00 | BOZEMAN | WQB,MSU | 2.5 |
| SEP 30 | CERTIFICATION EXAMINATIONS | BOZEMAN | WQB | |

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|---|---|---|---|---|
| OCT 11-13 (Evenings) | BASIC OPERATIONS FOR SMALL WATER SYSTEMS | KALISPELL | MRWS | .5 |

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|---|---|---|---|---|
| NOV 17 | BASIC OPERATIONS FOR SMALL WATER SYSTEMS | MISSOULA | MRWS | .5 |

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| | | | | |
|---|---|---|---|---|
| DEC 08 | BASIC WATER & WASTEWATER, $5.00 | GREAT FALLS | WQB,MRWS,NMC | .5 |

# MEASUREMENT OF WATER WELL DRAWDOWN AND SPECIFIC CAPACITY

*Reprinted with permission from the North Dakota Department of Health-Division of Water Supply and Pollution Control*

## INTRODUCTION

*Pumping tests of water supply wells can serve many purposes. Properly planned and conducted tests will reveal information about the performance and efficiency of the well being pumped. In addition, from the data obtained, calculations can be made which interpret groundwater aquifer performance.*

*Measuring each well for pump and well yield, depth to water level, drawdown, and specific capacity should be done on a routine basis. These test results should be compared with previous tests to estimate current well and/or aquifer conditions.*

## TERMINOLOGY

*It is important to understand the meaning of the terms used relating to the pumping test. Some of these terms are as follows:*

1. *Static Water Level. This is the level at which water stands in the well when no water is being pumped. It is generally expressed as the distance in feet from the ground surface to the water level in the well.*

2. *Pumping Level. This is the level at which water stands in the well when pumping is in progress. The pumping level may also be referred to as the dynamic water level.*

3. *Drawdown. When a well is pumped, the water level in the vicinity of the well will be lowered. Drawdown is the difference, measured in feet, between the static water level and the pumping level.*

4. *Well Yield. The well yield is the volume of water per unit of time discharged from a well either by pumping or by free flow.*

5. *Specific Capacity. Specific capacity of the well is its yield per unit of drawdown, usually expressed as gallons per minute (gpm) per foot of drawdown.*

## DETERMINATION OF DEPTH TO WATER LEVEL

1. *Wetted Tape Method. The wetted tape method will accurately measure the depth to water in a well and can be used for depths up to 100 feet or more. Attach a lead weight to the end of a steel measuring tape if needed. Wipe dry the lower three or four feet of the tape and coat with carpenter's chalk. Lower the tape into the well through the air vent or other opening until part of the chalked section is below water. Continue to lower the tape until the next even foot mark can be held exactly at a reference point and record the number of feet indicated. The tape is then removed from the well and the footage of chalked section washed away by the water is noted. Subtract this reading from the reading obtained at the top*

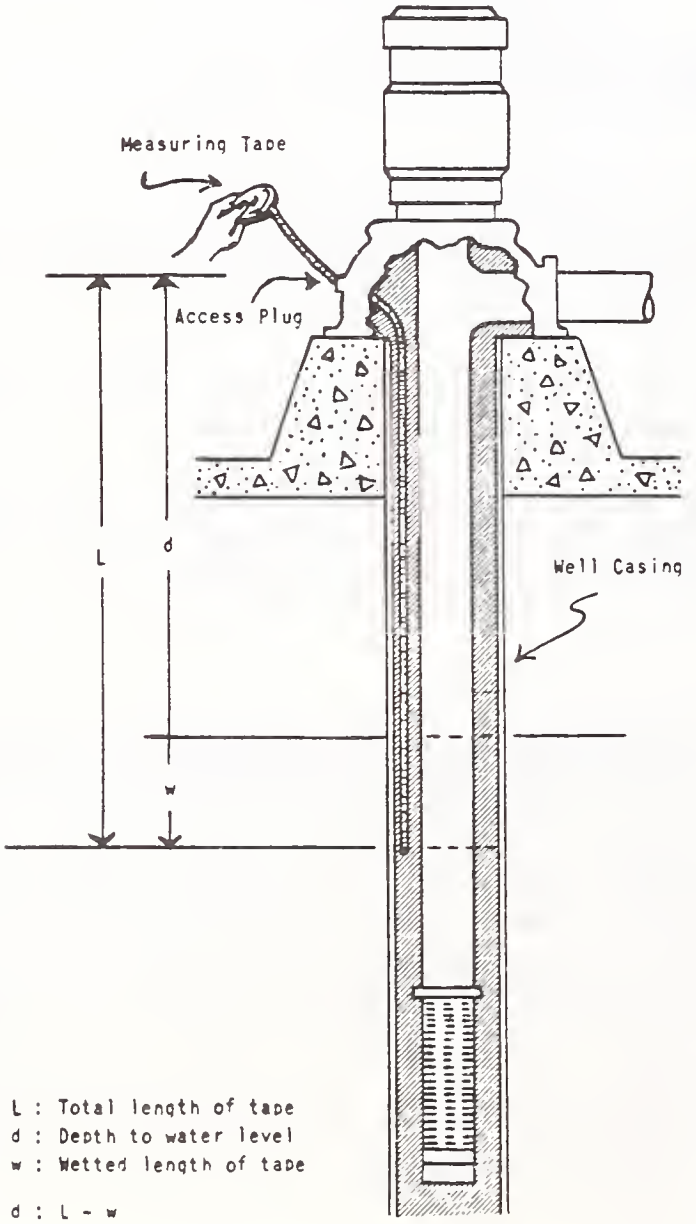
*reference point. The difference in these readings is the depth from the reference point to the water level.*

2. *Air Line Method. The air line method measures depth to water level by determining the air pressure required to push all of the water out of a submerged tube of known length. The air line consists of a 1/4 inch pipe, copper or plastic tubing, extending from the top of the well to a point several feet below the lowest anticipated water level. To avoid turbulence near the intake of the pump, the lower end of the air line should be at least 5 feet above or below the point where water enters the pump. The exact length of the air line must be known or should be measured as it is placed in the well. Make all joints airtight. The upper end of the tube is fitted with suitable connections for an air gauge, a tire valve, and an air pump.*

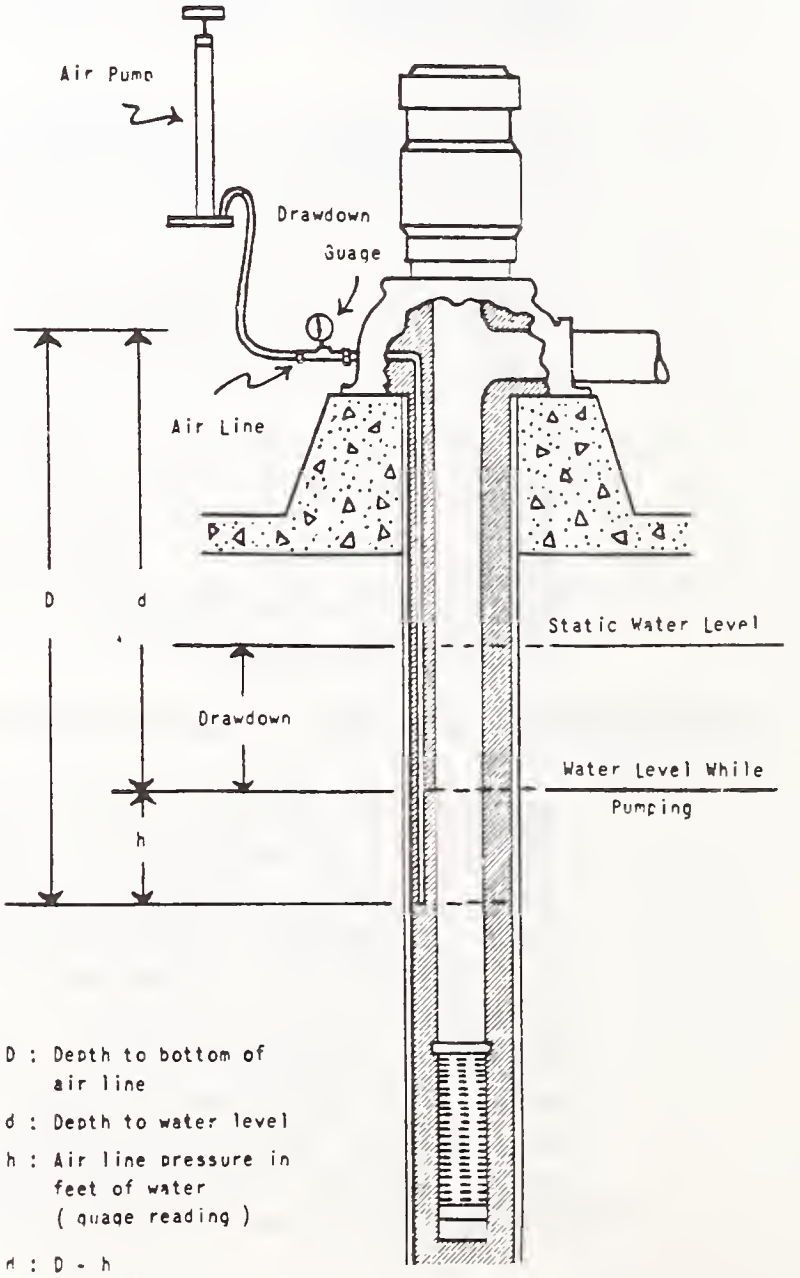
   *Pump the air into the line until the gauge pressure is constant. This indicates that all of the water has been expelled from the tube. The gauge reading shows the pressure necessary to support a column of water of a height equal to the depth the tube was submerged. If the gauge indicates feet of water, then it shows directly the submerged length of the line in feet. Subtracting the submerged length from the total length of the air line gives the depth to static water level. Gauges calibrated in pounds per square inch (psi) may be converted to feet of water by multiplying by 2.31.*

***MEASUREMENT OF WELL WATER DEPTH***

Wetted Tape Method




Air Line Method



## *DETERMINATION OF DRAWDOWN*

*First, determine the static water level by either the wetted tape method or the air line method. Second, after the well has achieved a constant pumping rate or yield, measure the depth to the water level. Again, this is done with either the wetted tape method or the air line method. The difference of these readings before and after pumping the well at a specific rate is measured in feet and is recorded as feet of drawdown.*

*Example:* *Depth to water before pumping = 100 feet*
*Depth to water after pumping = 125 feet*

*Drawdown = depth after pumping - depth before pumping*
*= 125 feet - 100 feet = 25 feet*

## *DETERMINATION OF SPECIFIC CAPACITY*

*Specific capacity is calculated by dividing the yield of the well in gallons per minute by the drawdown. Both measurements shall be taken at the same time.*

*Example:* *Yield of well = 160 gpm Drawdown = 20 feet*
*Specific capacity = 160/20 = 80 gpm per foot of drawdown*

## *MAINTAINING WELL RECORDS*

*Keep a dated maintenance record of all the information about the well. Report noted changes in water production and describe any repairs or improvements. Depth to water level and drawdown should be determined and recorded at routine intervals.*

## *SUGGESTED PERMANENT WELL RECORD*

*City of* _____

*Well Number* _____ *Location* _____

*Constructed by* _____ *Date* _____

*Casing Size* _____ *Length* _____ *Material* _____

*Screening Device* _____ *Length* _____

*Make of Pump* _____ *Capacity* _____

*Static Level* ___ *Length of Air Line* ___ *Drawdown* ___ *Specific Capacity* ___

***SUGGESTED MAINTENANCE AND OPERATIONAL RECORD***

| *Well No.* | *Date* | *Depth to Water (Static Level)* | *gpm* | *Drawdown in. ft.* | *Specific Capacity* | *Describe Any Repairs or Improvements* |
|---|---|---|---|---|---|---|
| *1* | *10/06/78* | *200'* | *60* | *10* | *6 gpm/ft* | *None* |
| *1* | *11/15/79* | *205'* | *60* | *11* | *5.5 gpm/ft* | *None* |

***INTERPRETATION OF WATER WELL PROBLEMS***

*With proper records of water well tests, well problems can be interpreted. Some rules to follow are:*

1. *If the output of the well (gpm) drops, the drawdown decreases, and the specific capacity remains the same, the problem is most likely the pump.*

2. *If the output of the well (gpm) drops, the static water level remains the same, the drawdown increases, and the specific capacity decreases, the well may be plugging. Acid clean the well when the specific capacity drops about 25 percent.*

3. *If the output of the well (gpm) drops and the static water level is declining, the aquifer may be depleting.*

# EDUCATING FUTURE WATER SYSTEM OPERATORS

By: Hugh Wilkins
Superintendent, Great Falls Water Treatment Plant

Of the many tasks performed by water treatment plant operators, surely one of the most pleasant, is conducting a tour of your facility. No greater opportunity exists to tell the story of water supply and treatment, and at the same time, create a good public impression.

At the Great Falls Water Treatment Plant we see nearly 2,000 visitors a year. Half of this number are 4th grade students touring the plant as a part of the Environmental Education Program developed by the Great Falls Public School District. The month of January is set aside for this activity with two full-time environmental science teachers, Mr. Dennis Maxson and Mr. John Cannon, lecturing and conducting the tours.

Two weeks of classroom preparation by home-room teachers precede the tours. Goals for the students include understanding the water treatment process, the importance of water conservation, recognizing the need for proper resource management, recognizing renewable and nonrenewable resources, and learning how various machines make work easier.

The Environmental Education Program was implemented in 1967. The program is mandatory for grades 1-6 and is integrated into the science curriculum. In addition to 4th-graders studying water and wastewater, the other grades and their specific areas of environmental study are: grade 1 - animal differences; grade 2 - fossils; grade 3 - solid waste and recycling, use of microscopes, and pond studies; grade 5 - evergreens, water pollution, noxious weeds, and soil conservation; and grade 6 - conservation, energy alternatives, ornithology, geology, and ecology. For grades 7-12 there are a variety of trips supported by curricular objectives. These programs are strongly encouraged and supported by the administration.

In 1987, the Great Falls Public School District's Environmental Science Department was selected by the National Science Teachers Association as one of ten exemplary environmental education programs in the United States. Those of us at the water treatment plant are proud to have an integral role in this first-rate program and are eager to remain an on-going part of it.

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# IN MEMORY OF KEITH H. HILL

By: Denise Ingman - Water Quality Bureau

If you were lucky enough to know Keith Hill, you knew you had a genuine friend. On January 6th, we lost this good friend and cohort to an apparent heart attack. His friendly conversation and willing participation at training events in Montana will be sorely missed.

Keith was born in Cloquet, Minnesota and graduated from Floodwood High School. He served with the Army Air Force in the Pacific on B-24 Bombers during World War II. Keith re-enlisted in the Air Force in 1948 to become a pilot instructor and flew in the Korean War. He later served with the 29th Fighter Interceptor Squadron at Malmstrom AFB.

After retiring as a major from the Air Force in October 1967, Keith and his wife Rae settled in Billings. Keith was elected to the Board of Directors of the Lockwood Water Users Association in 1971, a position he held until March, 1979, when he resigned to become manager of the association. Keith worked hard as the manager of Lockwood and he took his responsibilities very seriously. He was responsible for seeing the system through many tough decisions and changes, the latest being the building of a 2.7 MGD water treatment plant. Keith was highly respected by his fellow Lockwood employees. He was known as a "team player" as he was always worrying about someone else first.

Keith was also actively involved in the Montana Rural Water Association. He served as chairman of the legislative committee for five years and was elected to the Board of Directors in October 1986. The results of his work on the legislative committee have been beneficial to all small water systems in the state.

To Keith's family and friends, we wish to extend our sincere sympathy. We will all miss him.

# Operators Pass Exams

Listed below are the 50 men and women who passed certification examinations given September 18, 1987, in Bozeman. Twelve of these had been previously certified in another type as indicated by the asterisk. The next examinations for certification will be administered in seven Montana communities on March 12. Please see the Examination Notice in this CLEARWATER for further details.

CLASS 1:
Dan Becker, Colstrip,1AB-ot
Jerry DeVantier, Bozeman, 1B
*Stephen Feger, Hardin, 1A-ot
Ronald Foreman, Divide, 1A,1B
Steven Hudecek, Livingston, 1B-ot
Gerald Mathisen, Bozeman, 1A
Richard Miller, Bozeman, 1A
*Stanley Nelson, East Glacier, 1B-ot
Herbert Perkins, Miles City, 1B-ot
Thomas Radcliffe, Bozeman, 1B-ot
*Mark Richardson, Miles City, 1B-ot
Douglas Schnittgen, Harlem, 1B-ot
*Ronnie Shorter, Livingston, 1B-ot
William Slovensky, Bozeman, 1C
Melvin Spadt, Billings, 1B
Steve Theisen, Great Falls, 1C-ot
Bradford Towle, Helena, 1C-ot
Harlan Wise, Melstone, 1B-ot
David Wyrick, Forsyth, 1B-ot

CLASS 2:
Dan Becker, Colstrip, 2C-ot
*Rita Graham, Bigfork, 2B-ot
Kenneth Hagen, Lewistown, 2C
*Timothy Miller, Polson, 2A
William Rutherford, Lewistown, 2C
Timothy Sloughter, Helena, 2C-ot

CLASS 3:
*Terry Benson, Deer Lodge, 3A4B
Mathew Burden, West Yellowstone, 3C-ot
Arthur Garner, Missoula, 3C
Richard Gibby, Big Timber, 3A4B
*Rita Graham, Bigfork, 3A
James Houck, Belt, 3A-ot
Elston Loken, Ekalaka, 3A4B
*Robert Loss, Fairfield, 3C
Brooks, McMann, Whitefish, 3C-ot
James Putnam, Whitefish, 3C
Ed Rasmussen, White Sulphur Springs,3A4B
Daniel Teeter, Corwin Springs,3A4B,3C-ot
Douglas Schnittgen, Harlem, 3A
William Weber, Bozeman, 3A4B, 3C
Rob Werner, Billings, 3C
Jack Young, Belgrade, 4C

CLASS 4:
*Floyd Balentine, Butte, 4AB
Matthew Burden, West Yellowstone,4AB-ot
Everett Bauer, Billings, 4AB
Russell Clark, Geraldine, 4C
Richard Gibby, Big Timber, 4C
Joe Kenworthy, Virginia City, 4C
Bernard Lennemann, Wilsall, 4AB
*LeRoy Meyer, Sunburst, 4C
Robert Moog, Joplin, 4C
James Houck, Belt, 4B
*Bud Van Smith, Belgrade, 4C
*James Wilson, Butte, 4AB

CLASS 5:
Dustin Diteman, Belgrade, 5AB
James Radcliffe, Bozeman, 5AB
Dan Wood, Bozeman, 5AB

# WATER QUALITY BUREAU ENDORSED - *NOT LIKELY!!*

As the primary regulatory agency responsible for reviewing designs of water and sewer systems, we are often asked to approve materials or equipment for use within the state. While we do evaluate materials for conformance with the design standards (i.e AWWA approved pipe) or testing methods generally accepted by the industry, we do not endorse specific product names. If you are approached by a salesman claiming our endorsement, we suggest that you contact our office for verification and proceed with caution. This is especially true if the product being offered is new and/or is represented as having miraculous qualities never before available. "Scientific" data supporting these claims should also be considered questionable. While many new quality products enter the market each year, there are probably just as many marginal goods being sold with the intention of making the salesman some easy money.

On a related note, we are often asked to provide names, addresses, and phone numbers of public water and sewer system owners and operators to various individuals for marketing purposes. It is our policy not to do this although we may provide a general list of the system names and addresses upon request if we have that list available for other purposes. An example of this might be the distribution of our Construction Grants annual priority list. Here again, if anyone contacts you claiming our approval or endorsement via a list obtained from our office, they are misrepresenting themselves.

One other item should be mentioned. Occasionally we are asked to allow access to our files for various purposes. As a public agency, our files must be available to the public for their viewing if the documents do not leave our office. In this case, we cannot be held responsible for any information they might obtain.

## WHO'S THE ARTIST?

Many of you have probably wondered who the artist is that draws the cover for this publication. He is obviously very talented and we do appreciate the contribution he makes to the Clearwater.

The mystery man is Erich Weber and he is an Environmental Specialist with the Water Quality Bureau. When he isn't out wading in a river collecting stream samples, we keep him busy with the art work.

He has really done some fine art work and by looking at the cover of this issue, you can see that he is keeping up the tradition. Good work, Erich!

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Department of Health and
Environmental Sciences
Room A-206, Cogswell Building
Helena, Montana 59620

TO:



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